REMARKS

This Preliminary Amendment amends the originally-filed specification of the above-referenced U.S. application, via a substitute specification, to refer to and claim priority from Japanese Patent Application No. 2003-194913 filed July 10, 2003, pursuant to 37 C.F.R. § 1.78(a)(2). In addition, the original specification has been amended to remove minor informalities from the translation of the originally-filed international application. A marked-up comparison illustrating changes between the originally-filed specification and the substitute specification is enclosed herewith.

In addition, originally-filed claims 1-68 of the above-referenced application (translation in English provided herewith) have been cancelled without prejudice, and new claims 69-298 have been added to provide many of the originally filed claims 1-68 in an appropriate form for prosecution before the U.S. Patent and Trademark Office, and not due to any reason of patentability. Accordingly, claims 68-198 are now under consideration in the above-identified application. The amendments to the specification and new claims do not add new matter to the application.

Applicants assert that the present invention is new, non-obvious, and useful. Prompt consideration and allowance of the pending claims are respectfully requested.

Respectfully submitted,

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By: ______________________

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TO ALL WHOM IT MAY CONCERN:

Be it known that WE, Hirofumi IMAI, Naoya HAMADA, Motoi KIDO, Tatsuhiko SAKAI, Atsushi SUGIHASHI, Hideyuki HAMAMURA citizen(s) of Japan, whose post office address is c/o Nippon Steel Corporation Technical Development Bureau, 20-1, Shintomi, Futtsu-shi, Chiba 293-8511 Japan; and Satoshi YAMAGUCHI citizen of Japan, whose post office address is c/o Nippon Bunri University School of Engineering, 1727-162, Oaza-Ichigi, Oita-shi, Oita 870-0397, Japan; have invented an improvement in

SEMICONDUCTOR LASER DEVICE AND SOLID-STATE LASER DEVICE USING SAME

CROSS-REFERENCE TO RELATED APPLICATION(S)

[0001] **This application claims priority under 35 U.S.C. § 119 from Japanese Patent Application No. 2003-194913 filed on July 10, 2003, the entire disclosure of which is incorporated herein by reference.**

~~BACKGROUND~~FIELD OF THE INVENTION

~~1. Field of the Invention~~

[0002] ~~[0001]~~ The present invention relates to a beam converter **capable of being** used for a laser diode stack array and a laser device **that is capable of** using ~~that~~**such** beam converter. The present invention further relates to a semiconductor laser condenser ~~for~~**capable of** condensing semiconductor laser beams to a fine spot and a semiconductor laser pumped solid-state laser

SUBSTITUTE SPECIFICATION

device ~~for pumping~~**configured to pump** a beam of a solid-state laser element by semiconductor laser beams. A laser diode and a semiconductor laser is the same meanings here.

~~2. Description of the Related Art~~

BACKGROUND INFORMATION

[0003] ~~[0002] At the present time, linear~~**Linear** arrays of semiconductor lasers comprised of active layer stripes of semiconductor lasers arranged one dimensionally and having a continuous wave (CW) output of about 50W ~~are~~**have been** available. Linear arrays of semiconductor laser, for example as shown in FIG. 1, comprise from 10 to several tens of stripes with ends of widths of 100 μm to 200 μm serving as emitters arranged at fixed intervals in a plane over a total width of 1 cm.

[0004] ~~[0003]~~ By stacking several of these semiconductor laser linear arrays to form a two-dimensional array as shown in FIG. 2, it is possible to easily obtain an increased output. Such a two-dimensional semiconductor laser array is called a "semiconductor laser stack array" or a "semiconductor laser stack bar". Ones with kW class outputs are available on the market. If it were possible to directly condense the laser beams of the stack array using an optical system so as to obtain a sufficiently fine spot, it ~~should be~~**is likely** possible to use ~~it~~**such laser beams** for a various applications such as laser materials processing.

[0005] ~~[0004]~~ It ~~is~~**may be** possible to obtain from a single semiconductor laser stack array a light source comprised of line segments arranged in a two-dimensional array emitting (10 to several tens) × n number of laser beams where n is the number of stack layers. Further, a high output semiconductor laser such as a quasi-CW semiconductor laser ~~gives~~**provides** a light source

with a large number of emitters arranged densely, with emission beams mixing with emission beams from adjoining lasers right after emission, and with substantially consecutive linear light sources arranged corresponding to the number of stack layers.

[0006] ~~[0005]~~ Each stripe beam is emitted from a linear light source. The beam divergence angle has a large vertical component ϕ with respect to the active layer of about 40° to 50° and a small parallel component θ of about 10°. Below, the large divergence angle direction perpendicular to an active layer will be called the "fast axis", while the small divergence angle direction parallel to an active layer will be called the "slow axis". The width of the emission light source is a narrow one of not more than 1 μm at the fast axis side and a broad one of 100 μm to 200 μm as explained above at the slow axis side.

[0007] ~~[0006]~~ For example, consider a laser diode ("LD") stack array comprised of several stacked linear arrays each comprised of 12 stripes of thicknesses of 1 μm and widths of 200 μm arranged at a pitch of 800 μm. The slow axis component of a stripe beam has a beam divergence angle of 10°, so adjoining stripe beams become superposed with each other at 3.4 mm from the emitter ends of the stripes. When placing a lens after this superposition, part of the beams become beams having angles with respect to the axis of the lens and are focused at points different from the focal point of the focusing lens, so the efficiency of the system is lowered.

[0008] ~~[0007]~~ Therefore, in order to collimate the beams emitted from the stripe arrays using a microcylindrical lens array, it is necessary to place a lens (focal length $f1 \leq 3.4$ mm) at a close position of within 3.4 mm. If multiplying the magnification (f2/f1) determined by the

combination with the focal length f2 of the condensing lens for condensing the collimate beams with the width of the stripes to find the focused spot diameter, it inevitably becomes large.

[0009] ~~[0008]~~ In this way, in the past, it was difficult to concentrate the emission laser beams of an LD stack bar giving a light source comprised of line segments arranged in a two-dimensional array to a small area with a high density. To utilize ~~a~~**the** LD stack array for laser processing or medical applications, which account for the major part of industrial applications for high power lasers, some special means is required for concentrating the beam energy in a narrow region.

[0010] ~~[0009]~~ Further, if ~~attempting~~**an attempt is made** to use a semiconductor laser stack array as a pumped light source of a solid-state laser~~,~~ **(**as ~~explained~~**described** above**)**, since the width of the array is about 1 cm, it ~~was~~**may** not **be** possible to focus ~~a plurality of~~ beams to a single spot using an ordinary lens system and the high pumping efficiency end pumping system ~~could~~**may** not be used, so application was **previously** only possible for side pumping systems. On the other hand, for the end pumping system in which pumping light comes from the direction of optical axis of the solid-state laser, it is possible to obtain high efficiency single fundamental lateral mode oscillation by matching the pumping space by the semiconductor laser output beams with the mode space of the solid-state laser oscillation.

[0011] ~~[0010]~~ Further, matching of the pumping space ~~is~~**can be** important in a double clad fiber laser, considered an advanced form of an end pumped solid-state laser~~, as well~~. A double clad fiber laser can also be considered a high efficient brightness raising device, but the input aperture of the pumping light is a narrow some 600 μm × 240 μm, so for obtaining a higher

output, a special ~~means~~**may** was ~~required~~**previously used** for concentrating the rather high level semiconductor laser beams.

SUMMARY OF THE INVENTION

[0012] ~~[0011]~~ In view of the above problems, ~~an object~~**one of the objects** of the present invention is to provide a novel beam converter used for a semiconductor laser device using a semiconductor laser stack array, and able to raise the energy density by making the focal point of the semiconductor laser device extremely small and to provide a semiconductor laser device using this beam converter to raise the energy density at the focal point of the semiconductor laser device using a semiconductor laser stack array.

[0013] ~~[0012] Still another~~**Another** object of the present invention is to provide a powerful semiconductor laser pumped solid-state laser device using the above semiconductor laser device.

[0014] ~~[0013] The~~**An exemplary embodiment of the** present invention ~~solves~~**can solve** the above**-described** problems~~ and has as its gist the following. Note that in the description~~**. For the purposes of describing the exemplary embodiments** of the present invention, "in front" ~~means the~~**can mean a** focal point side~~. Further, to facilitate understanding,~~**, and** the reference numerals of the examples are ~~shown~~**indicated** in parentheses.

~~[0014]~~ ~~[1]~~ ~~A semiconductor laser device provided with:~~

[0015] **Therefore, an exemplary embodiment of a semiconductor laser device according to the present invention includes** a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, **adapted** to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having

laser beam elements arranged in a two-dimensional array~~;~~**. The laser device also includes a first condenser provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction. Further, the laser device includes a first beam converter provided in front of the first condenser, and adapted to receive a group of laser beams collimated in the second direction, and configured to emit the laser beams converted to a substantially ladder rung configuration group of laser beams extending in the first direction for every row.**

~~[0016] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0017] a first beam converter (30) provided in front of the first condenser (20), receiving the group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in the first direction for every row;~~

[0016] ~~[0018]~~ **According to this exemplary embodiment,** a second condenser ~~(80)~~**can be** provided in front of the first beam converter ~~(30), bending and collimating~~**, which is adapted to bend and collimate** the group of laser beams output from the first beam converter ~~(30)~~ in a second direction substantially at right angles to the first direction for every row, and ~~using~~**configured to use** each with center axes offset by exactly predetermined amounts to convert them to beams emitted from approximately the same object by generating an angular

change of the optical axes~~;~~**. In addition, the laser device includes a first beam compressor that is capable of receiving the group of laser beams output from the second condenser, and emitting them converted to a compressed substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows. A third condenser can also be provided for condensing the group of laser beams output from the first beam compressor.**

~~[0019] a first beam compressor (40) receiving the group of laser beams output from the second condenser (80) and emitting it converted to a compressed substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows; and~~

~~[0020] a third condenser (70) for condensing the group of laser beams output from the first beam compressor (40).~~

~~[0021] [2] A semiconductor laser device provided with:~~

[0017] ~~[0022] one of~~**Another exemplary embodiment of a semiconductor laser device according to the present invention can include a laser beam array or** a laser diode stack array provided with a plurality of emitters~~, extending long~~**. The emitters can extend** in a first direction of emission of laser beams, ~~to~~**and may** be arranged linearly in the first direction ~~and arranged~~ in a plurality of rows and emitting a group of laser beams having laser beam elements ~~arranged in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting~~**. The lase beam**

elements can be arranged in the two-dimensional array. The emitters may can emit a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;.

~~[0023] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

[0018] ~~[0024]~~ **A first condenser may also be provided in front of the laser diode stack array, and adapted to bend and collimate a group of laser beams for every row in a second direction substantially at right angles to the first direction. The laser device may also include** a first beam converter ~~(30)~~ provided in front of the first condenser, dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units;.

[0019] ~~[0025] a~~**A** second condenser ~~(80)~~**may be** provided in front of the first beam converter, bending and collimating the group of laser beams output from the first beam converter ~~(30)~~ in a second direction substantially at right angles to the first direction for every row, and using each with center axes offset by exactly predetermined amounts to convert them to beams emitted from approximately the same object by generating an angular change of the optical axes;**. In addition,**

a first beam compressor is provided which is adapted to receive the group of laser beams output from the second condenser, and emit the beams converted to a substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows. The laser device also includes a third condenser configured to condense the group of laser beams output from the first beam compressor.

~~[0026] a first beam compressor (40) receiving the group of laser beams output from the second condenser (80) and emitting it converted to a substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows; and~~

~~[0027] a third condenser (70) for condensing the group of laser beams output from the first beam compressor (40).~~

~~[0028] [3] A semiconductor laser device provided with:~~

[0020] ~~[0029]~~ **Still another exemplary embodiment of a semiconductor laser device according to the present invention can include** a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, ~~to be~~**and capable of being** arranged linearly in the first direction and arranged in a plurality of rows**,** and ~~emitting~~**configured to emit** a group of laser beams having laser beam elements arranged in a two-dimensional array~~;~~**. A first condenser i salso provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction. In addition , th elaser device**

may include a first beam converter provided in front of the first condenser, which is adapted to receive the group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in the first direction for every row;

~~[0030] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0031] a first beam converter (30) provided in front of the first condenser (20), receiving the group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in the first direction for every row;~~

~~[0032] a second condenser (80) provided in front of the first beam converter (30) and bending and collimating the group of laser beams output from the first beam converter (30) in a second direction substantially at right angles to the first direction for every row;~~

~~[0033] a first beam compressor (40) receiving the group of laser beams output from the second condenser (80) and emitting it converted to a compressed substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows;~~

[0021] ~~[0034] an angle changer~~**A second condenser can also be provided in front of the first beam converter, and adapted to bend and collimate the group of laser beams output from the first beam converter (30) in a second direction substantially at right angles to the**

first direction for every row. The laser device further includes a first beam compressor that is capable of receiving the group of laser beams output from the second condenser and emitting the beams converted to a compressed substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows. An angle changer is also provided in front of one of the second condenser ~~(80)~~ and the first beam compressor (40), **capable of** receiving the substantially ladder rung configuration group of laser beams extending in the first direction of the plurality of rows, and ~~changing~~**adapted to change** the center optical axes of the group of beams to the second direction for each row to obtain a group of beams emitted from substantially the same object~~; and~~**. Further, the laser device can include a third condenser for condensing the group of laser beams changed in center optical axes.**

~~[0035] a third condenser (70) for condensing the group of laser beams changed in center optical axes.~~

~~[0036] [4] A semiconductor laser device provided with:~~

[0022] ~~[0037] one of~~**Yet another exemplary embodiment of a semiconductor laser device according to the present invention can include (i)** a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array~~and~~**, or (ii)** a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of

rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows~~;~~**. A first condenser may be provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction. A first beam converter may be provided in front of the first condenser, so as to divide the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receive the group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emit the beams as a substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units. The laser device may also include a second condenser provided in front of the first beam converter, and configured to bend and collimate the group of laser beams output from the first beam converter in a second direction substantially at right angles to the first direction for every row. A first beam compressor may also be provided to receive the group of laser beams output from the second condenser, and emit the beams converted to a substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows. An angle changer may be provided in front of the second condenser or the first beam compressor, which is adapted to receive the substantially ladder rung configuration group of laser beams extending in the first direction of the plurality of rows, and change the center optical axes of the group of beams to the second direction for each row to obtain a group of beams emitted from substantially**

the same object. FUrther the laser device may include a third condenser configured to condense the group of laser beams.

~~[0038] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0039] a first beam converter (30) provided in front of the first condenser (20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units;~~

~~[0040] a second condenser (80) provided in front of the first beam converter (30), bending and collimating the group of laser beams output from the first beam converter (30) in a second direction substantially at right angles to the first direction for every row;~~

~~[0041] a first beam compressor (40) receiving the group of laser beams output from the second condenser (80) and emitting it converted to a substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows;~~

~~[0042] an angle changer provided in front of one of the second condenser (80) and the first beam compressor (40), receiving the substantially ladder rung configuration group of laser beams~~

~~extending in the first direction of the plurality of rows, and changing the center optical axes of the group of beams to the second direction for each row to obtain a group of beams emitted from substantially the same object; and~~

~~[0043]~~ ~~a third condenser (70) for condensing the group of laser beams.~~

[0023] ~~[0044]~~ ~~[5]~~ ~~A semiconductor laser device as set forth in [3] or [4], wherein one of~~**According to a further exemplary embodiment of the present invention,** the second condenser ~~(80) and~~**or** the first beam converter ~~(40) and the angle changer are formed~~**can be** integrally **formed with the angle changer**.

~~[0045]~~ ~~[6]~~ ~~A semiconductor laser device provided with:~~

~~[0046]~~ ~~a~~

[0024] **Yet another exemplary embodiment of a semiconductor laser device according to the present invention can include a** laser diode stack array ~~provided with a~~ **provided with a** plurality of emitters, extending long ~~in a~~ **in a** first direction of emission of laser beams, ~~to be~~**capable of being** arranged linearly ~~in the~~ **in the** first direction ~~and~~ **and** arranged ~~in a~~ **in a** plurality of rows ~~and~~ **and** emitting a group of laser beams having laser beam elements arranged ~~in a~~ **in a** two-dimensional array~~;~~

~~[0047]~~ ~~a~~**. A** first condenser ~~(20) provided in front of the~~ **may be provided front of the** laser diode stack array ~~and~~ **and** bending ~~and~~ **and** collimating the group of laser beams for every row ~~in a~~ **in a** second direction substantially at right angles to the first direction~~;~~

~~[0048]~~ ~~a~~**. A** first beam converter ~~(30) provided in front of the first~~ **may be provided in front of the first** condenser ~~(20), receiving the group of laser beams~~**, so as to receive the group of**

laser beams collimated~~in the~~ **in the** second direction,~~ and emitting it~~ **and emit the beams** converted to a substantially ladder rung configuration group of laser beams extending~~ in the first~~ **in the first** direction for every row~~;~~

~~[0049]~~ ~~a second condenser (80) provided in front of the first beam converter (30) and bending and collimating the group of laser beams~~**. A second condenser may be provided in front of the first beam converter so as to bend and collimate the group of laser beams** output from the first beam converter~~ (30) in a second~~ **in a second** direction substantially at right angles to the first direction for every row~~; and~~

~~[0050]~~ ~~a~~**. The laser device also may include a** third condenser ~~(70) for receiving the group of laser beams~~ **adapted for receiving the group of laser beams** output from the second condenser ~~(80)~~**(80)**, forming images,~~ and reduce the~~ **and reducing the** distance between rows.

~~[0051]~~ ~~[7]~~ ~~A semiconductor laser device provided with:~~

~~[0052]~~ ~~one of~~

[0025] **A firther exemplary embodiment of a semiconductor laser device according to the present invention can include (i)** a laser diode stack array~~ provided~~ **provided** with a plurality of emitters, extending long ~~in a~~ **in a** first direction of emission of laser beams, ~~to be~~ **capable of being** arranged linearly~~ in the~~ **in the** first direction~~ and~~ **and** arranged ~~in a~~ **in a** plurality of rows ~~and emitting a group of laser beams~~ **and emitting a group of laser beams** having laser beam elements arranged~~ in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting a group of~~

~~laser beams~~ **in a two-dimensional array, or (ii) a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, and capable of being arranged linearly densely in the first direction, provided in a plurality of rows, and emitting a group of laser beams** comprised of laser beams substantially continuing linearly arranged ~~in a plurality of rows;~~

~~[0053] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams~~ **in a plurality of rows;**

[0026] The laser device according to this exemplary embodiment may include a first condenser provided in front of the laser diode stack array, and adapted to bend and collimate the group of laser beams for every row in a second direction substantially at right angles to the first direction~~;~~

~~[0054] a first~~ **. A first** beam converter ~~(30) provided in front of the first~~ **may be provided in front of the first** condenser ~~(20),~~ **, thus** dividing the group of laser beams in each row, providing in each row in parallel optical elements for ~~bending the~~ **bending the** axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, ~~receiving the group of laser beams~~ **receiving the group of laser beams** collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, ~~and emitting the beams as a~~ **and emitting the beams as a** substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units~~;~~

~~[0055] a second condenser (80) provided in front of the first beam converter (30) and bending and collimating the group of laser beams~~**. A second condenser may be provided in front of the first beam converter, and adapted to bend and collimate the group of laser beams** output from the first beam converter ~~(30) in~~ **in** a second direction substantially at right angles to the first direction for every row~~; and~~

~~[0056]~~ **. Further,** a third condenser ~~(70) for receiving the group of laser beams,~~ **may be provided for receiving the group of laser beams,** forming images, ~~and reducing the~~ **and reducing the** distance between rows.

~~[0057] [8] A semiconductor laser device provided with:~~

~~[0058] a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams~~

[0027] Still further exemplary embodiment of a semiconductor laser device according to the present invention can include a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged ~~in a~~ **in a** two-dimensional array~~;~~

~~[0059] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams~~**. A first condenser may be arranged in front of the laser diode stack array and bending, and adapted to collimate the group of laser beams** for every row in a second direction substantially at right angles to the first direction~~;~~

~~[0060] a first beam converter (30) provided in front of the first condenser (20), receiving the group of laser beams .~~ **. A first beam converter may be provided in front of the first condenser, thus receiving the group of laser beams** collimated in the second direction, ~~and emitting it converted to a~~ **and emitting the beams converted to a** substantially ladder rung configuration group of laser beams extending in the first direction for every row~~;~~

~~[0061] a second condenser (80) provided in front of the first beam converter (30) and bending and collimating the group of laser beams~~**. A second condenser may be provided in front of the first beam converter, and configured to bend and collimate the group of laser beams** output from the first beam converter ~~(30)~~ in ~~a~~ **a** second direction substantially at right angles to the first direction for every row~~;~~

~~[0062] a~~ **. A** fourth condenser ~~(71) provided in front of the~~ **may be provided in front of the** second condenser ~~(80), receiving the~~ **, and provided for receiving the** substantially ladder rung configuration group of laser beams extending ~~in the first direction of the plurality of~~ **in the first direction of the plurality of** rows, forming images, ~~and reducing the~~ **and reducing the** distance between rows~~; and~~

~~[0063] a~~ **. The laser device can include a** third condenser ~~(70) for further reducing and~~ **for further reducing and** reforming the image from the fourth condenser ~~(71).~~

~~[0064] [9] A semiconductor laser device provided with:~~

~~[0065] one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements~~

~~arranged in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams .~~ ,

[0028] **Yet another exemplary embodiment of a semiconductor laser device according to the present invention can include (i) a laser diode stack array provided with a plurality of emitters, provided for extending long in a first direction of emission of laser beams, to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array, or (ii) a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams** substantially continuing linearly arranged ~~in a plurality of rows;~~

~~[0066]~~ ~~a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a~~ **in a plurality of rows. A first condenser may be provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a** second direction substantially at right angles to the first direction ~~;~~

~~[0067]~~ ~~a~~**. A** first beam converter ~~(30) provided in front of the first condenser (20), dividing the~~ **may be provided in front of the first condenser, dividing the** group of laser beams **in each row, providing** in each row ~~, providing~~ in ~~each row in~~ parallel optical elements for ~~bending the~~

bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, ~~receiving the~~ **receiving the** group of laser beams collimated ~~in the~~ **in the** second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, ~~and emitting the beams as a~~ **and emitting the beams as a** substantially ladder rung configuration group of laser beams extending ~~in the first~~ **in the first** direction using the divided pluralities of laser ~~beams as units;~~

~~[0068] a second condenser (80) provided in front of the first beam converter (30) and bending and collimating the~~ **beams as units.**

[0029] The laser device of this exemplary embdoiment may also include a second condenser provided in front of the first beam converter, and adapted to bend and collimate the group of laser beams output from the first beam converter ~~(30) in a~~ **in a** second direction substantially at right angles ~~to the~~ **to the** first direction for every row~~;~~

~~[0069] a fourth condenser (71) provided in front of the second condenser (80), receiving the substantially ladder rung configuration group of laser beams extending in the first direction of the plurality of rows, forming images, and reducing the distance between rows; and~~

~~[0070] a third condenser (70) for further reducing and reforming the image from the fourth condenser (71).~~ **A fourth condenser may be provided in front of the second condenser, and adapted for receiving the substantially ladder rung configuration group of laser beams extending in the first direction of the plurality of rows, forming images, and reducing the distance between rows. Further, a third condenser can be provided for further reducing and reforming the image from the fourth condenser.**

[0030] ~~[0071] [10] A semiconductor laser device as set forth in [8] or [9], further provided with~~**According one exemplary variant of the present invention,** an angle changer **may also be** provided at the image-forming plane of the fourth condenser or in its vicinity and changing the center optical axes of the group of beams to the second direction for each row to obtain a group of beams emitted from substantially the same object.

~~[0072] [11] A semiconductor laser device provided with:~~

[0031] **A further exemplary embodiment of a semiconductor laser device according to the present invention can include a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, capable of being arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array. A first condenser may be provided in front of the laser diode stack array, and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction. A first beam converter may be provided in front of the first condenser, soa s to receive the group of laser beams collimated in the second direction, and emitting the lasers converted to a substantially ladder rung configuration group of laser beams extending in the first direction for every row.**

[0032] **A second condenser can be provided in front of the first beam converter, and adapted for bending and collimating the group of laser beams output from the first beam converter in a second direction substantially at right angles to the first direction for every row. A first beam compressor can receive the group of laser beams output from the second condenser, and emit the received laser beams converted into a compressed substantially**

ladder rung configuration group of laser beams extending in the first direction of the plurality of rows . A second beam compressor may be provided in front of the first beam compressor, and emit the laser beams output from the first beam compressor converted into a group of laser beams with shortened intervals of the rows and compressed in the second direction of the plurality of rows.

[0033] The laser device of this exemplary embodiment may include a fourth condenser for receiving the beams output from the second beam compressor, and making the beam divergence angle in the first direction close to the beam divergence angle of the second direction. A third condenser may be provided for condensing the group of laser beams output from the fourth condenser.

[0034] ~~[0073]~~ Another exemplary embodiment of a semiconductor laser device according to the present invention can include (i) a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, ~~to be~~ arranged linearly in the first direction and arranged in a plurality of rows, and capable of emitting a group of laser beams having laser beam elements arranged in a two-dimensional array~~;~~ or (ii) a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, arranged linearly densely in the first direction and arranged in a plurality of rows, and capable of emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows. A first condenser may be provided in front of the laser diode stack array and bending, and configured to collimate the group of laser beams for every row in a second direction substantially at right angles to the first direction. A first beam converter may be provided in front of the first condenser,

thus dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units. A second condenser may be provided in front of the first beam converter (30) and bending and collimating the group of laser beams output from the first beam converter (30) in a second direction substantially at right angles to the first direction for every row.

~~[0074]~~ ~~a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0075]~~ ~~a first beam converter (30) provided in front of the first condenser (20), receiving the group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in the first direction for every row;~~

~~[0076]~~ ~~a second condenser (80) provided in front of the first beam converter (30) and bending and collimating the group of laser beams output from the first beam converter (30) in a second direction substantially at right angles to the first direction for every row;~~

~~[0077]~~ ~~a first beam compressor (110, 111) receiving the group of laser beams~~

[0035] The laser device according to this exemplary embodiment also may include a first beam compressor that receives the group of laser beams output from the second condenser ~~(80) and emitting it converted into a~~ **and emit the beams converted into a** compressed substantially ladder rung configuration group of laser beams extending in the first direction of the plurality of rows~~;~~

~~[0078]~~ ~~a~~**. A** second beam compressor ~~(112, 113) provided in~~ **may be provided in** front of the first beam compressor ~~(110, 111) and emitting the laser beams~~**, and adapted to emit the laser beams** output from the first beam compressor ~~(110, 111) converted into a group of laser beams with~~ **converted into a group of laser beams with** shortened intervals of the rows and compressed in the second direction of the plurality of rows~~;~~

~~[0079]~~ ~~a~~**. A** fourth condenser ~~(60) for receiving the beams~~ **may be provided for receiving the beams** output from the second beam compressor ~~(113) and~~ **, and** making the beam divergence angle in the first direction close to the beam divergence angle of the second direction~~; and~~

~~[0080]~~ ~~a~~**. Further, a** third condenser ~~(70) for~~ **may be provided for** condensing the group of laser beams output from the fourth condenser ~~(60)~~.

~~[0081]~~ ~~[12]~~ ~~A semiconductor laser device provided with:~~

~~[0082]~~ ~~one of a laser diode stack array provided,~~

[0036] A still further exemplary embodiment of a semiconductor laser device according to the present invention can include a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in

the first direction and arranged in a plurality of rows and ~~emitting a group of laser beams~~ **emitting a group of laser beams** having laser beam elements arranged in a two-dimensional array ~~and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~[0083]~~ ~~a first condenser (20) provided in~~ **. A first condenser may be provided in** front of the laser diode stack array ~~and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0084]~~ ~~a first beam converter (30) provided in~~ **, and adapted for bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction. A first beam converter may be provided in** front of the first condenser ~~(20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams~~ **, and adapted for receiving the group of laser beams** collimated in the second direction, ~~rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially~~ **and emitting the beams converted to a substantially** ladder rung configuration group of laser beams extending in the first direction ~~using the divided pluralities of laser beams as units;~~

~~[0085] a second condenser (80) provided in~~ **for every row. A second condenser may also be provided in** front of the first beam converter ~~(30) and bending and collimating the group of laser beams~~ **, and configured to bend and collimate the group of laser beams** output from the first beam converter ~~(30) in a second direction substantially at right angles to the first direction for every row;~~

~~[0086] a first beam compressor (110, 111) receiving the group of laser beams~~ **(30) in a second direction substantially at right angles to the first direction for every row.**

[0037] The laser device according to this exemplary embodiment may also include a first beam compressor adapted for receiving the group of laser beams output from the second condenser ~~(80)~~, and ~~emitting it~~ **emitting the beams** converted into ~~a~~ **a** compressed substantially ladder rung configuration group of laser beams **with shortened ladder rung intervals and** extending in the first direction of the plurality of rows~~;~~

~~[0087] a second~~ **. A second** beam compressor ~~(112, 113) provided in~~ **may be provided in** front of the first beam compressor ~~(110, 111) and emitting the laser beams output from the first beam compressor (110, 111) converted into a group of laser beams~~ **, and adapted for emitting the laser beams converted into a compressed group of laser beams** with shortened intervals of the rows and ~~compressed in the second direction of the plurality of rows;~~

~~[0088] a fourth condenser (60) for receiving the beams output from the second beam compressor (113) and making the beam divergence angle in the first direction close to the beam divergence angle of the second direction; and~~

~~[0089]~~ ~~a third condenser (70) for~~ **extending in the second direction of the plurality of rows. An angle changer may be provided inside the first beam compressor or the second beam compressor, and may be configured to change the optical axis angles. A third condenser may be provided for** condensing the group of laser beams~~-output from the fourth condenser (60).~~

~~[0090]~~ ~~[13]~~ ~~A semiconductor laser device provided with:~~

~~[0091]~~ ~~a laser~~**,**

[0038] Another exemplary embodiment of a semiconductor laser device according to the present invention can include (i) a laser diode stack array provided ~~with a~~ **with a** plurality of emitters, extending long in ~~a first~~ **a first** direction of emission of laser beams, ~~to be~~**which may be** arranged linearly in the first direction and arranged in ~~a~~ **a** plurality of rows~~-and emitting a group of laser beams~~ **, and adapted to emit a group of laser beams** having laser ~~beam elements arranged in a two-dimensional array;~~

~~[0092]~~ ~~a first condenser (20) provided in~~ **beam elements arranged in a two-dimensional array or (ii) a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows. A first condenser may be provided in** front of the laser diode stack array~~-and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0093] a first beam converter (30) provided in front of the first condenser, receiving the group of laser beams~~ **, and adapted for bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction. A first beam converter can be provided in front of the first condenser, dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams** collimated in the second direction, ~~and emitting it converted to a substantially ladder rung~~ **rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung** configuration group of laser beams extending in the first direction ~~for every row;~~

~~[0094] a second condenser (80) provided in~~ **using the divided pluralities of laser beams as units;**

[0039] The laser device according to the present invention may include a second condenser that may be provided in front of the first beam converter ~~(30) and bending and collimating the group of laser beams output from the first beam converter (30) in a second direction substantially at right angles to the first direction for every row;~~

~~[0095] a first beam compressor (150, 151) receiving the group of laser beams output from the second condenser (80) and emitting it converted into a~~ **, so as to bend and collimate the group of laser beams output from the first beam converter in a second direction substantially at right angles to the first direction for every row. A first beam compressor may receive the**

group of laser beams output from the second condenser, and emitting th ebeams converted into a compressed substantially ladder rung configuration group of laser beams ~~with shortened ladder rung intervals and extending in the first~~ **extending in the first** direction of the plurality of rows~~;~~

~~[0096] a second~~ **,**

[0040] The exemplary laser device may also include a second beam compressor ~~(152, 153) provided in~~ **provided in** front of the first beam compressor ~~(150, 151) and emitting the laser beams converted into a~~ **, and capable of emitting the laser beams output from the first beam compressor converted into a** compressed group of laser beams ~~with shortened~~ **with shortened** intervals of the rows ~~and extending in the second~~ **and extending in the second** direction of the plurality of rows~~;~~

~~[0097] an angle changer provided inside one of the first beam compressor (150, 151) and the second beam compressor (150, 151) and~~ **. An angle changer may be provided inside one of the first beam compressor and the second beam compressor, and** changing the optical axis angles~~; and~~

~~[0098] a third condenser (70) for~~ **. Further, a third condenser may be provided for** condensing the group of laser beams~~.~~

~~[0099] [14] A semiconductor laser device provided with:~~

~~[0100] one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements~~

~~arranged in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~[0101]~~ ~~a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0102]~~ ~~a first beam converter (30) provided in front of the first condenser (20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units;~~

~~[0103]~~ ~~a second condenser (80) provided in front of the first beam converter (30) and bending and collimating the group of laser beams output from the first beam converter (30) in a second direction substantially at right angles to the first direction for every row;~~

~~[0104]~~ ~~a first beam compressor (110, 111) receiving the group of laser beams output from the first second condenser (80) and emitting it converted into a compressed substantially ladder rung configuration group of laser beams extending in the first direction of the plurality of rows;~~

~~[0105] a second beam compressor (112, 113) provided in front of the first beam compressor (110, 111) and emitting the laser beams output from the first beam compressor (110, 111) converted into a compressed group of laser beams with shortened intervals of the rows and extending in the second direction of the plurality of rows;~~

~~[0106] an angle changer provided inside one of the first beam compressor (110, 111) and the second beam compressor (112, 113) and changing the optical axis angles; and~~

~~[0107] a third condenser (70) for condensing the group of laser beams.~~

~~[0108]~~ [15] ~~A semiconductor laser device as set forth in [13] or [14], wherein the beam compressors are comprised by a two-dimensional beam compressor (140, 141) combining the functions of the first beam compressor and second beam compressor.~~,

[0041] ~~[0109]~~ ~~[16]~~ ~~A semiconductor laser device as set forth in [13] or [14], further provided with~~**According to one exemplary variant of the present invention, the beam compressors can include a two-dimensional beam compressor combining the functions of the first beam compressor and second beam compressor. In addition,** a second beam converter ~~(50)~~**may be** provided between the first beam compressor and the second beam compressor, **which is capable of** receiving the substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows, converting it to substantially ladder rung configuration laser beams extending in the second direction for each row, and as a result emitting ~~it~~**the beams** converted to a single row of substantially ladder rung configuration laser beams with all laser beams extending in the second direction. **Alternatively, a second beam converter may be provided between the first beam compressor and the**

second beam compressor, which is adapted for receiving the substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows, converting it to substantially ladder rung configuration laser beams extending in the second direction for each row, and as a result emitting the beams converted to a single row of substantially ladder rung configuration laser beams with all laser beams extending in the second direction. Such exemplary laser device may also include an angle changer provided in front of the second beam converter and changing the center optical axes of the group of beams to the second direction to obtain a group of beams emitted from substantially the same object.

~~[0110]~~ ~~[17] A semiconductor laser device as set forth in [16], further provided with:~~

~~[0111]~~ ~~a second beam converter (50) provided between the first beam compressor and the second beam compressor, receiving the substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows, converting it to substantially ladder rung configuration laser beams extending in the second direction for each row, and as a result emitting it converted to a single row of substantially ladder rung configuration laser beams with all laser beams extending in the second direction and~~

~~[0112]~~ ~~an angle changer provided in front of the second beam converter (50) and changing the center optical axes of the group of beams to the second direction to obtain a group of beams emitted from substantially the same object.~~

[0042] ~~[0113]~~ ~~[18]~~ ~~A semiconductor laser device as set forth in [16] or [17], further provided with~~**According to another exemplary variant of the present invention,** a fifth condenser

~~(154)~~**may be** provided between the first beam compressor and the second beam converter, **which is capable of** receiving the substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in the first direction of the plurality of rows, and emitting ~~it~~**the beams, and** bending and collimating the laser beams of each row. **The fifth condenser may be a cylindrical lens.**

~~**[0114]** [19] A semiconductor laser device as set forth in [18], wherein the fifth condenser (154) is a cylindrical lens.~~

[0043] ~~**[0115]** [20] A semiconductor laser device as set forth in any one of [1] to [19], further provided with a shifter provided between the first beam converter and the second~~ **In addition, a shifter can be provided between the first beam converter and the second** condenser and shifting ~~in parallel optical axes in the second direction for each row.~~ **in parallel optical axes in the second direction for each row. The shifter provided may also be provided between the first condenser and the first beam converter and shifting in parallel optical axes in the second direction for each row. The second condenser may be a one-dimensional array of cylindrical lenses.**

~~**[0116]** [21] A semiconductor laser device as set forth in any one of [1] or [20], further provided with a shifter provided between the first condenser and the first beam converter and shifting in parallel optical axes in the second direction for each row.~~

~~**[0117]** [22] A semiconductor laser device as set forth in any one of [1] to [21], wherein the second condenser is a one-dimensional array of cylindrical lenses.~~

~~**[0118]** [23] A semiconductor laser device provided with:~~

[0044] ~~[0119]~~ **A further exemplary embodiment of a semiconductor laser device according to the present invention can include** a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, ~~to be~~**capable of being** arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array~~;~~**. A first condenser may be provided in front of the laser diode stack array, and configured to bend and collimate the group of laser beams for every row in a second direction substantially at right angles to the first direction. A second beam compressor can be provided in front of the first condenser, and adapted for receiving the group of laser beams collimated in the second direction, and emitting the laser beams converted into a group of laser beams with compressed distances between optical axes in the second direction.**

~~[0120] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0121] a second beam compressor (112, 113) provided in front of the first condenser (20), receiving the group of laser beams collimated in the second direction, and emitting the laser beams converted into a group of laser beams with compressed distances between optical axes in the second direction;~~

[0045] ~~[0122]~~ **This exemplary laser device may also include** a first beam converter ~~(50)~~ provided in front of the second beam compressor ~~(112, 113)~~**, configured for** dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the

axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams collimated in the second direction and compressed in distance between optical axes in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units~~;~~**. A first beam compressor may be provided in front of the first beam converter, and adapted for emitting the laser beams converted into a group of laser beams compressed in the first direction. A second condenser may be provided in front of the first beam compressor, and adapted for making the beam divergence angle of the first direction close to the divergence angle of the second direction. Further, a third condenser may be provided for condensing the group of laser beams.**

~~[0123]~~ ~~a first beam compressor (110, 111) provided in front of the first beam converter (50) and emitting the laser beams converted into a group of laser beams compressed in the first direction;~~

~~[0124]~~ ~~a second condenser (60) provided in front of the first beam compressor (110, 111) and making the beam divergence angle of the first direction close to the divergence angle of the second direction; and~~

~~[0125]~~ ~~a third condenser (70) for condensing the group of laser beams.~~

~~[0126]~~ ~~[24]~~ ~~A semiconductor laser device provided with:~~

[0046] ~~[0127] one of~~**Still a further exemplary embodiment of a semiconductor laser device according to the present invention can include (i)** a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, **adapted** to be arranged linearly in the first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array ~~and~~**, or (ii)** a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, ~~to~~**adapted** be arranged linearly densely in the first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows~~;~~**. A first condenser may be provided in front of the laser diode stack array and configured for bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;**

~~[0128] a first condenser (20) provided in front of the laser diode stack array and bending and collimating the group of laser beams for every row in a second direction substantially at right angles to the first direction;~~

~~[0129] a second beam compressor (112, 113) provided in front of the first condenser (20), receiving the group of laser beams collimated in the second direction, and emitting the laser beams converted into a group of laser beams with compressed distances between optical axes in the second direction;~~

[0047] ~~[0130] a first beam converter (50)~~**The exemplary laser device may also include a second beam compressor provided in front of the first condenser, adapted for receiving the**

group of laser beams collimated in the second direction, and emitting the laser beams converted into a group of laser beams with compressed distances between optical axes in the second direction. A first beam converter may be provided in front of the second beam compressor~~(112, 113)~~, **capable of** dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving the group of laser beams collimated in the second direction and compressed in distance between optical axes in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in the first direction using the divided pluralities of laser beams as units~~;~~. **A first beam compressor may be provided in front of the first beam converter, and configured for emitting the laser beams converted into a group of laser beams compressed in the first direction.**

~~[0131] a first beam compressor (110, 111) provided in front of the first beam converter (50) and emitting the laser beams converted into a group of laser beams compressed in the first direction;~~

[0048] ~~[0132]~~ **The exemplary laser device may also include** a second condenser ~~(60)~~ provided in front of the first beam compressor~~(110, 111)~~, and **adapted for** making the beam divergence angle of the first direction close to the divergence angle of the second direction~~; and~~. **A third condenser may be provided for condensing the group of laser beams.**

~~[0133] a third condenser (70) for condensing the group of laser beams.~~

[0049] ~~[0134] [25] A semiconductor laser device as set forth in [24], further provided with~~**In another exemplary variant of the present invention,** a fifth condenser ~~(155)~~**may be** provided between the second beam compressor and the first beam converter**, which is adapted for** receiving a group of laser beams with distances between optical axes in the second direction compressed, and emitting the laser beams of each row bent and collimated in the second direction. **The fifth condenser may be a cylindrical lens. An angle changer may also be provided in front of the second beam compressor, and the angle changer may be adapted for changing the center optical axes of the group of beams to obtain a group of beams emitted from substantially the same object. The angle changer may be an inclined transparent plate, an array of wedge prisms, an array of cylindrical lenses and/or a segment type reflection mirror.**

~~[0135] [26] A semiconductor laser device as set forth in [25], wherein the fifth condenser (155) is a cylindrical lens.~~

~~[0136] [27] A semiconductor laser device as set forth in [25] or [26], further provided with, in front of the second beam compressor (110, 111), an angle changer changing the center optical axes of the group of beams to obtain a group of beams emitted from substantially the same object.~~

~~[0137] [28] A semiconductor laser device as set forth in any one of [3] to [5], [10], [13] to [14], [17] to [22], and [27], wherein the angle changer is one of an inclined transparent plate and an array of wedge prisms.~~

~~[0138]~~ ~~[29]~~ ~~A semiconductor laser device as set forth in any one of [3] to [5], [10], [13] to [14], [17] to [22], and [27] to [28], wherein the angle changer is an array of cylindrical lenses.~~

~~[0139]~~ ~~[30]~~ ~~A semiconductor laser device as set forth in any one of [3] to [5], [10], [13] to [14], [17] to [22], and [27] to [29], wherein the angle changer is a segment type reflection mirror.~~

~~[0140]~~ ~~[31]~~ ~~A semiconductor laser device as set forth in any one of [1] to [30], wherein the beam compressor is comprised of one of an anamorphic prism and anamorphic prism pair.~~

~~[0141]~~ ~~[32]~~ ~~A semiconductor laser device as set forth in any one of [1] to [31], wherein the beam compressor is a telescope using one of one-dimensional and two-dimensional lenses.~~

~~[0142]~~ ~~[33]~~ ~~A semiconductor laser device as set forth in any one of [1] to [32], wherein the beam compressor is a telescope using one of a one-dimensional and two-dimensional parabolic mirror.~~

~~[0143]~~ ~~[34]~~ ~~A semiconductor laser device as set forth in any one of [1] to [33], wherein the first condenser is a one-dimensional array of cylindrical lenses.~~

[0050] ~~[0144]~~ ~~[35]~~ ~~A semiconductor laser device as set forth in any one of [1] to [34], further~~**The beam compressor may be comprised of one of an anamorphic prism and anamorphic prism pair, and can be a telescope that uses a one-dimensional lense or a two-dimensional lenses, and/or a one-dimensional and two-dimensional parabolic mirror. The first condenser may be a one-dimensional array of cylindrical lenses. In addition, an angle adjuster may be** provided~~,~~ in front of the first condenser, ~~with an~~**the** angle adjuster **being adapted** for finely adjusting the angle of optical axes for each row to the second direction. **The**

angle adjuster can combine at least two wedge plates in reverse directions, and can rotate at least one wedge plate.

~~[0145]~~ ~~[36] A semiconductor laser device as set forth in [35], wherein the angle adjuster combines at least two wedge plates in reverse directions and can rotate at least one wedge plate.~~

~~[0146]~~ ~~[37] A semiconductor laser device as set forth in any one of [1] to [36], using as a beam converter a beam converter comprising a plurality of optical elements each provided with:~~

~~[0147]~~ ~~a receiving part for receiving incident light beams having cross-sections perpendicular to the optical axes as first axes,~~

~~[0148]~~ ~~an optical system for rotating the first axis of the beam cross-sections to substantially right angles, and~~

~~[0149]~~ ~~an emission part for emitting emitted beams passing through the optical system,~~

[0051] ~~[0150]~~ ~~the~~**Each of the optical elements may be provided with a receiving part for receiving incident light beams having cross-sections perpendicular to the optical axes as first axes, an optical system for rotating the first axis of the beam cross-sections to substantially right angles, and an emission part for emitting emitted beams passing through the optical system. The** optical elements arranged on the optical axes of the laser beams and the receiving parts and emission parts of the optical elements arranged adjoining each other two-dimensionally on the same planes.

~~[0151]~~ ~~[38] A semiconductor laser device as set forth in [37], wherein the optical element is a space defined by reflecting faces, the space providing a first reflecting face vertical and inclined about 45° with respect to incident beams, a second reflecting face parallel to the incident beams~~

~~and inclined about 45° with respect to the horizontal plane, and a third reflecting face perpendicular to the vertical surface parallel to the incident beams, parallel to the line of intersection between the first reflecting face and second reflecting face, and inclined about 45° with respect to the horizontal plane.~~

[0052] ~~**[0152]** [39] A semiconductor laser device as set forth in [37], wherein the optical element is~~**The optical element can be a space defined by reflecting faces, with the space providing a first reflecting face vertical and inclined about 45° with respect to incident beams, a second reflecting face parallel to the incident beams and inclined about 45° with respect to the horizontal plane, and a third reflecting face perpendicular to the vertical surface parallel to the incident beams, parallel to the line of intersection between the first reflecting face and second reflecting face, and inclined about 45° with respect to the horizontal plane. The optical element may be** a prism comprised of a first total reflecting face, a second total reflecting face, a third total reflecting face, an incidence face, an emission face, and a joining face, in which prism the first, second, and third total reflecting faces intersect each other with intersecting angles of 60°, the incidence face and emission face are parallel and perpendicularly intersect the second total reflecting face and are inclined about 45° with respect to the first and third total reflecting faces, and the joining face is parallel to the second total reflecting face, and wherein one of a one-dimensional array of prisms comprised of the prisms arranged adjoining each other with the third total reflecting faces, incidence faces, and emission faces on the same planes and with joining faces and second total reflecting faces of adjoining prisms joined together and a two-dimensional array comprised of one-dimensional arrays of prisms further aligned in parallel is used as the beam converter.

[0053] ~~[0153] [40] A semiconductor laser device as set forth in [37], wherein one of an~~An optical glass member ~~having~~**may be provided which have** parallel first and second flat surfaces, a third flat surface intersecting the first flat surface by an angle of 135°, and a fourth surface comprised of a cyclically bent surface comprised of peaks and valleys having a bending angle of the line along which the peaks and valleys extend of 60°~~,~~**. The surfaces can be** formed continuously in a wave configuration in a direction intersecting the first flat surface by an angle of $\tan^{-1}(1/\sqrt{2})$, and having peak lines and valley lines parallel to the third flat surface, the first flat surface being used as an incidence face, the second flat surface being used as an emission face, the faces among the bent faces forming the fourth surface intersecting the first flat surface by an angle of 45° being used as a first reflecting face, the other faces being used as a second reflecting face, and the third flat surface being used as a third reflecting face**. In addition or alternatively**,~~, and~~ a one-dimensional array **may be provided which is** comprised of the optical glass members further aligned linearly is used as a beam converter.

[0054] ~~[0154] [41] A semiconductor laser device as set forth in [37], wherein one of a~~A mirror structure **may also be provided** having a first flat surface intersecting a flat surface perpendicular to an incidence optical axis by an angle of 135°, a second surface comprised of a cyclically bent surface comprised of peaks and valleys having a bending angle of the line along which the peaks and valleys extend of 60°~~,~~**. The surfaces can be** formed continuously in a wave configuration in a direction intersecting a flat surface perpendicular to the incidence optical axis by an angle of $\tan^{-1}(1/\sqrt{2})$, and having peak lines and valley lines parallel to the first flat surface, the first flat surface and the second surface being treated to form mirror surfaces, the faces

among the bent faces forming the second surface intersecting the flat surface perpendicular to the incidence optical axis by an angle of 45° being used as a first reflecting face, the other faces being used as a second reflecting face, and the first flat surface being used as a third reflecting face**. Alternatively or in addition**, ~~and~~ a one-dimensional array **may be provided which is** comprised of the mirror structures further aligned linearly is used as a beam converter.

~~[0155]~~ ~~[42]~~ ~~A semiconductor laser device as set forth in [37], wherein the optical element is comprised of a pair of convex cylindrical lenses each with axes inclined about 45° arranged facing each other across a space of a predetermined distance.~~

[0055] ~~[0156]~~ ~~[43]~~ ~~A semiconductor laser device as set forth in [37], wherein the optical element is~~**The optical element may be comprised of a pair of convex cylindrical lenses each with axes inclined about 45° arranged facing each other across a space of a predetermined distance. The optical element may also be** comprised of an array of a plurality of pairs of convex cylindrical lenses each with axes inclined about 45° arranged facing each other across a space of a predetermined distance**. In the pairs of cylindrical lenses, a radius of curvature of emission side lenses may be smaller than a radius of curvature of incidence side lenses.**

~~[0157]~~ ~~[44]~~ ~~A semiconductor laser device as set forth in [42] or [43], wherein in the pairs of cylindrical lenses, a radius of curvature of emission side lenses is smaller than a radius of curvature of incidence side lenses.~~

[0056] ~~[0158]~~ ~~[45]~~ ~~A semiconductor laser device as set forth in [37], wherein the~~**The** optical element ~~is~~**may also be** a cylindrical lens having convex lens parts at the two ends of the side faces and wherein a plurality of optical elements are joined inclined by about 45° with respect to

an incidence optical axis. **The beam converter may be a one-dimensional array of a plurality of cylindrical lenses having convex lens parts at the two ends of the side faces joined inclined by about 45° with respect to an incidence optical axis. In the convex lens parts, a radius of curvature of emission side lenses may be smaller than a radius of curvature of incidence side lenses.**

~~[0159]~~ ~~[46] A semiconductor laser device as set forth in [37], wherein the beam converter is a one-dimensional array of a plurality of cylindrical lenses having convex lens parts at the two ends of the side faces joined inclined by about 45° with respect to an incidence optical axis.~~

~~[0160]~~ ~~[47] A semiconductor laser device as set forth in [45] or [46], wherein in the convex lens parts, a radius of curvature of emission side lenses is smaller than a radius of curvature of incidence side lenses.~~

[0057] ~~[0161]~~ ~~[48] A semiconductor laser device as set forth in [37], wherein the~~**The** beam converter ~~is~~**may be** comprised of an optical glass prism having a rectangular cross-section formed with a plurality of cylindrical surfaces inclined about 45° in the same direction as its incidence face and emission face and emits incident beams entering its cylindrical surfaces rotated about 90° in cross-section. **In the cylindrical surfaces, a radius of curvature of emission side surfaces can be smaller than a radius of curvature of incidence side surfaces, with the angle of inclination adjusted to emit incident beams entering its cylindrical surfaces rotated about 90° in cross-section.**

~~[0162]~~ ~~[49] A semiconductor laser device as set forth in [48], wherein, in the cylindrical surfaces, a radius of curvature of emission side surfaces is smaller than a radius of curvature of~~

~~incidence side surfaces, with the angle of inclination adjusted to emit incident beams entering its cylindrical surfaces rotated about 90° in cross-section.~~

~~[0163]~~ ~~[50]~~ ~~A semiconductor laser device as set forth in [37], wherein the optical element is a dub prism having a trapezoidal cross-section and a plurality of the optical elements is arranged inclined by about 45°.~~

~~[0164]~~ ~~[51]~~ ~~A semiconductor laser device as set forth in [37], wherein the optical element is comprised of two optical elements changing in power in only a direction perpendicular to a center axis due to diffraction and arranged with center axes inclined about 45°.~~

[0058] ~~[0165]~~ ~~[52]~~ ~~A semiconductor laser device as set forth in [37], wherein the beam converter is~~**The optical element may also be a dub prism having a trapezoidal cross-section and a plurality of the optical elements is arranged inclined by about 45°. Further, the optical element can be comprised of two optical elements changing in power in only a direction perpendicular to a center axis due to diffraction and arranged with center axes inclined about 45°. The beam converter may also be** comprised of, at both the incidence side and emission side, a pair of binary optic elements arranged facing each other across a space of a predetermined distance, the surfaces of the incidence side binary optic element and emission side binary optic element being formed with pluralities of axially symmetric stepped surfaces changing in depth so that the powers change symmetric to center axes inclined about 45° in directions perpendicular to the center axes, and emits incident beams entering the axially symmetric stepped surfaces rotated about 90° in cross-section.

~~[0166]~~ ~~[53]~~ ~~A semiconductor laser device as set forth in [37], wherein the optical element is comprised of an optical element comprised of a structure with continuously changing refractive indexes and changing in power in only a direction perpendicular to the orientation of arrangement and is arranged inclined 45° with respect to a horizontal plane.~~

~~[0167]~~ ~~[54]~~ ~~A semiconductor laser device as set forth in [37], wherein the beam converter is comprised of a plurality of one-dimensional profile refractive index lens elements comprised of optical glass members with refractive indexes highest at the center faces and becoming lower the closer to the side faces and joined with the center faces inclined about 45° with respect to a horizontal plane.~~

[0059] ~~**[0168]**~~ ~~[55]~~ ~~A semiconductor laser device as set forth in [37], wherein the beam converter is~~**In a further exemplary variant of the present invention, the optical element may be comprised of an optical element comprised of a structure with continuously changing refractive indexes and changing in power in only a direction perpendicular to the orientation of arrangement and is arranged inclined 45° with respect to a horizontal plane. Alternatively, the beam converter is comprised of a plurality of one-dimensional profile refractive index lens elements comprised of optical glass members with refractive indexes highest at the center faces and becoming lower the closer to the side faces and joined with the center faces inclined about 45° with respect to a horizontal plane. The beam converter may also be** comprised of an optical glass plate on both surfaces of which are formed pluralities of semicylindrical profile refractive index lens elements inclined about 45° with respect to those surfaces, arranged facing each other in the same direction, and having refractive indexes highest

at the centers of the semicylinders and refractive indexes becoming lower the further to the outsides.

~~[0169]~~ ~~[56] A semiconductor laser device as set forth in any one of [1] to [55], provided with at least two laser diode stack arrays provided with the first condensers in front and provided with an optical device for coupling the at least two groups of laser beams emitted from the first condensers in front of the condensers.~~

~~[0170]~~ ~~[57] A semiconductor laser device as set forth in any one of [1] to [55], provided with at least two laser diode stack arrays and provided with an optical device for wavelength coupling the at least two groups of laser beams entering the third condenser after the condenser.~~

[0060] ~~[0171]~~ ~~[58] A semiconductor laser device as set forth in any one of [1] to [55], provided with at~~**The laser device according to an exemplary embodiment of the present invention may include at least two laser diode stack arrays provided with the first condensers in front and provided with an optical device for coupling the at least two groups of laser beams emitted from the first condensers in front of the condensers. An optical device may also be provided for wavelength coupling at least two groups of laser beams entering the third condenser after the condenser. At** least three laser diode stack arrays **may be** provided with the first condensers in front and provided with an optical device for coupling the at least two groups of laser beams emitted from the first condensers in front of the condensers and provided with an optical device for wavelength coupling at least two groups of laser beams entering the third condenser after the condenser. **The optical device may be a polarization element, a mirror formed with through windows at the same pitch as the stack**

pitch of the laser diode stack array, mirrors arranged at the same pitch as the stack pitch of the laser diode stack array, right angle prisms arranged at the same pitch as the stack pitch of the laser diode stack array and/or a dichroic mirror.

~~**[0172]**~~ ~~[59] A semiconductor laser device as set forth in [56] or [58], wherein the optical device is a polarization element.~~

~~**[0173]**~~ ~~[60] A semiconductor laser device as set forth in [56] or [58], wherein the optical device is a mirror formed with through windows at the same pitch as the stack pitch of the laser diode stack array.~~

~~**[0174]**~~ ~~[61] A semiconductor laser device as set forth in [56] or [58], wherein the optical device is comprised of mirrors arranged at the same pitch as the stack pitch of the laser diode stack array.~~

~~**[0175]**~~ ~~[62] A semiconductor laser device as set forth in [56] or [58], wherein the optical device is comprised of right angle prisms arranged at the same pitch as the stack pitch of the laser diode stack array.~~

~~**[0176]**~~ ~~[63] A semiconductor laser device as set forth in [57] or [58], wherein the optical device is a dichroic mirror.~~

~~**[0177]**~~ ~~[64] A semiconductor laser device as set forth in any one of [1] to [63], further provided with an optical fiber having an end face at a focal plane of the third condenser.~~

~~**[0178]**~~ ~~[65] A semiconductor laser device as set forth in [64], wherein the optical fiber is an optical fiber with a core doped with a rare earth element.~~

~~[0179]~~ ~~[66]~~ ~~A semiconductor laser pumped solid-state laser device provided with a semiconductor laser device as set forth in any one of [1] to [65] and a solid-state laser element with a pumped light receiving face matched with a focal position of the third condenser.~~

[0061] ~~[0180]~~ ~~[67]~~ ~~A semiconductor laser pumped solid-state laser device provided with a semiconductor laser device as set forth in [64],~~**An optical fiber may also be provided that has an end face at a focal plane of the third condenser. The optical fiber may include a core doped with a rare earth element. The semiconductor laser pumped solid-state laser device may be provided with a semiconductor laser device and a solid-state laser element with a pumped light receiving face matched with a focal position of the third condenser. The laser device may include** an optical system for collimating the beams emitted from the optical fiber as set forth in ~~[64]~~ so as to converge them to the focal point, and a solid-state laser element having a pumped light receiving face and having the pumped light receiving face matched with the position of the focal point. **The optical fiber may be an optical fiber with a core doped with a rare earth element.**

~~[0181]~~ ~~[68]~~ ~~A semiconductor laser pumped solid-state laser device as set forth in [67], wherein the optical fiber is an optical fiber with a core doped with a rare earth element.~~

~~[0182]~~ ~~The semiconductor laser device of the present invention can condense the laser energy produced by a laser diode stack array to an extremely small area, so can be sufficiently used for laser processing or medical applications.~~

[0062] ~~[0183]~~ **The semiconductor laser device of an exemplary embodiment of the present invention can condense the laser energy produced by a laser diode stack array to an**

extremely small area, so can be sufficiently used for laser processing or medical applications. Further, a semiconductor laser device ~~using~~**may use** a beam converter **of an exemplary embodiment** of the present invention to achieve the effect of aligning the emitters of a semiconductor laser stack array in a substantially single row ladder rung configuration can concentrate the energy of the semiconductor laser stack array at an extremely small focal point.

~~[0184]~~ ~~Further, the semiconductor laser pumped solid-state laser device of the present invention can achieve end pumping utilizing powerful semiconductor lasers~~ **Further, the semiconductor laser pumped solid-state laser device according to the exemplary embodiment of the present invention can achieve end pumping utilizing powerful semiconductor lasers,** and obtain a solid-state laser output with a high efficiency and good beam quality.

BRIEF DESCRIPTION OF THE DRAWINGS

[0063] ~~[0185]~~ FIG. 1 is a view for explaining a laser diode array and directionality of laser beams.

[0064] ~~[0186]~~ FIG. 2 is a view for explaining a laser diode stack array and directionality of laser beams.

[0065] ~~[0187]~~ FIG. 3 is a view of the state of image formation when parallel beams enter a condensing lens with a **particular** focal length ~~f~~.

[0066] ~~[0188]~~ FIG. 4 is a view of the state of image formation when beams having optical axes which are parallel, but having divergence angles enter a condensing lens.

[0067] ~~[0189]~~ FIG. 5 is a view of the state of giving an angle so that a plurality of beams are emitted from a common imaginary object ~~O~~ placed on the center axis of the lens.

[0068] ~~[0190]~~ FIG. 6 is a view for explaining the operation for reducing the distance between center axes of a plurality of beams.

[0069] ~~[0191]~~ FIG. 7 is a plan view of an **exemplary** embodiment of a semiconductor laser device ~~of~~**according to** the present invention.

[0070] ~~[0192]~~ FIG. 8 is an elevation view of ~~a~~**an exemplary** semiconductor laser device of the present invention.

[0071] ~~[0193]~~ FIG. 9 is a plan view of ~~a~~**an exemplary** semiconductor laser device of the present invention using a dense emitter structure semiconductor laser.

[0072] ~~[0194]~~ FIG. 10 is an elevation view of the semiconductor laser device shown in FIG. 9.

[0073] ~~[0195]~~ FIG. 11 is a plan view of ~~a~~**an exemplary embodiment of the** semiconductor laser device ~~of~~**according to** the present invention ~~using~~**that uses** transparent wedge plates as a means for changing the beam angles.

[0074] ~~[0196]~~ FIG. 12 is an elevation view of the semiconductor laser device shown in FIG. 11.

[0075] ~~[0197]~~ FIG. 13 is a plan view of ~~a~~**an exemplary embodiment of the** semiconductor laser device ~~of~~**according to** the present invention combining a beam converter and transparent wedge plates integrally.

[0076] ~~[0198]~~ FIG. 14 is an elevation view of the semiconductor laser device shown in FIG. 13.

[0077] ~~[0199]~~ FIG. 15 is a plan view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention ~~using~~that uses a cylindrical lens as the means for changing the beam angles.

[0078] ~~[0200]~~ FIG. 16 is an elevation view of the semiconductor laser device shown in FIG. ~~15~~15.

[0079] ~~[0201]~~ FIG. 17 is a plan view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention designed to make the center axes of the beams closer.

[0080] ~~[0202]~~ FIG. 18 is an elevation view of the semiconductor laser device shown in FIG. 17.

[0081] ~~[0203]~~ FIGS. 19A to 19C are views ~~for explaining~~illustrating the state of change of an image in the semiconductor laser device shown in FIG. 17 and FIG. 18.

[0082] ~~[0204]~~ FIG. 20 is a plan view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention forming an image by further reducing the output of the semiconductor laser device shown in FIG. 17 and FIG. 18.

[0083] ~~[0205]~~ FIG. 21 is an elevation view of the semiconductor laser device shown in FIG. 19.

[0084] ~~[0206]~~ FIG. 22 is a side view ~~for explaining a~~illustrating the semiconductor laser device shown in FIG. 20 and FIG. 21 provided with an optical axis angle changing function near the focal point of the second condensing lens relating to the stack direction and configured to form an image by a final condensing lens.

[0085] ~~[0207]~~ FIG. 23 is a plan view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention ~~using~~that uses two one-dimensional telescopes as means for bringing the center axes of the beams closer.

[0086] ~~[0208]~~ FIG. 24 is a plan view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention ~~using~~that uses two one-dimensional telescopes as means for bringing the center axes of the beams closer and transparent wedge plates as means for making the objects match.

[0087] ~~[0209]~~ FIG. 25 is an enlarged view of the portion for setting the transparent wedge plates of FIG. 24.

[0088] ~~[0210]~~ FIGS. 26A and 26B are views for explaining the state of change of an image in the semiconductor laser device shown in FIG. 25.

[0089] ~~[0211]~~ FIG. 27 is a plan view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention ~~using~~that uses a telescope as the means for bringing the center axes of the beams closer.

[0090] ~~[0212]~~ FIG. 28 is an elevation view of the semiconductor laser device shown in FIG. 27.

[0091] ~~[0213]~~ FIGS. 29A and 29B are views for explaining the state of change of an image in the semiconductor laser device shown in FIG. 27 and FIG. 28.

[0092] ~~[0214]~~ FIG. 30 is a perspective view of an example of a configuration providing a second beam converter between an array direction telescope and stack direction telescope in addition to the example shown in FIG. 25.

[0093] ~~[0215]~~ FIG. 31 is a view showing appearance of ghosts when laser beams pass through a second beam converter.

[0094] ~~[0216]~~ FIG. 32 is a view of ~~a~~**an exemplary embodiment of the** semiconductor laser device ~~arranging~~**according to the present invention that provides** a cylindrical lens (**e.g., a** fifth condenser) between a first beam compressor and second beam converter.

[0095] ~~[0217]~~ FIG. 33 is a perspective view of a configuration adding stack direction and array direction transparent wedge plates to the arrangement of FIG. 30.

[0096] ~~[0218]~~ FIG. 34 is a view of another **exemplary embodiment of the** semiconductor laser device ~~arranging a~~**providing the** cylindrical lens (**e.g., the** fifth condenser) between a first beam compressor and second beam converter.

[0097] ~~[0219]~~ FIG. 35 is a view ~~for explaining~~**illustrating** an optical axis shift due to a beam shifter.

[0098] ~~[0220]~~ FIG. 36 is a perspective view of a configuration removing one beam converter from the arrangement of FIG. 30 and switching the array direction and stack direction telescopes.

[0099] ~~[0221]~~ FIGS. 37A and 37B are views ~~for explaining the~~**illustrating an** action of the second beam converter in the device of FIG. 36.

[00100] ~~[0222]~~ FIG. 38 is a perspective view of a configuration adding stack direction and array direction transparent wedge plates to the arrangement of FIG. 36.

[00101] ~~[0223]~~ FIG. 39 is a view of another **exemplary embodiment of the** semiconductor laser device ~~arranging a~~**providing the** cylindrical lens (**e.g., the** fifth condenser) between a first beam compressor and second beam converter.

[00102] ~~[0224]~~ FIG. 40 is a perspective view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention ~~using~~that uses segment type reflection mirrors as ~~the means~~a way for changing the beam angles.

[00103] ~~[0225]~~ FIG. 41 is a view of an example of an angle adjuster.

[00104] ~~[0226]~~ FIG. 42 is a view of the precision of angle adjustment.

[00105] ~~[0227]~~ FIG. 43 is a plan view for explaining a semiconductor laser pumped solid-state laser device according to an exemplary embodiment of the present invention.

[00106] ~~[0228]~~ FIG. 44 is a schematic elevation view for explaining the semiconductor laser pumped solid-state laser device shown in FIG. 43.

[00107] ~~[0229]~~ FIG. 45 is a plan view of ~~a~~an exemplary embodiment of the semiconductor laser device ~~of~~according to the present invention ~~using~~that uses an optical fiber.

[00108] ~~[0230]~~ FIG. 46 is a schematic elevation view of the semiconductor laser device shown in FIG. 45.

[00109] ~~[0231]~~ FIG. 47 is a schematic plan view for explaining an optical fiber guided semiconductor laser pumped solid-state laser device according to an exemplary embodiment of the present invention.

[00110] ~~[0232]~~ FIG. 48 is a schematic elevation view ~~for explaining an~~illustrating the optical fiber guided semiconductor laser pumped solid-state laser device shown in FIG. 47.

[00111] ~~[0233]~~ FIG. 49 is a schematic plan view ~~for explaining~~illustrating the semiconductor laser pumped fiber laser device of the present invention.

[00112] ~~[0234]~~ FIG. 50 is a schematic elevation view ~~for explaining~~**illustrating** the semiconductor laser pumped fiber laser device of the present invention.

[00113] ~~[0235]~~ FIG. 51 is a schematic view ~~for explaining~~**illustrating** a first beam converter, beam compressor, and second beam converter **according to an exemplary embodiment** of the present invention.

[00114] ~~[0236]~~ FIG. 52 is a view ~~for explaining the~~**illustrating a** principle of beam conversion by three reflection actions using three right angle prisms.

[00115] ~~[0237]~~ FIG. 53 is a perspective view of an optical element shaped as a prism and beam conversion by the same.

[00116] ~~[0238]~~ FIG. 54 is a perspective view of a beam converter obtained by arranging the optical elements of FIG. 53 in parallel and beam conversion by the same.

[00117] ~~[0239]~~ FIG. 55 is a perspective view of an integral beam converter equivalent to the beam converter of FIG. 54 and beam conversion by the same.

[00118] ~~[0240]~~ FIG. 56 is a perspective view of a first beam converter obtained by stacking beam converters of FIG. 55 and beam conversion by the same.

[00119] ~~[0241]~~ FIG. 57 is a perspective view of a first beam converter obtained by stacking mirror arrays and beam conversion by the same.

[00120] ~~[0242]~~ FIG. 58 is a perspective view of a first beam converter comprised of cylindrical lenses arranged in parallel and beam conversion by the same.

[00121] ~~[0243]~~ FIG. 59 is a perspective view of a first beam converter comprised of optical elements having an incidence face and emission face as cylindrical surfaces and beam conversion by the same.

[00122] ~~[0244]~~ FIG. 60 is a perspective view of a first beam converter fabricated from a block of optical glass and beam conversion by the same.

[00123] ~~[0245]~~ FIG. 61 is a perspective view of a first beam converter comprised of dub prisms arranged in parallel and beam conversion by the same.

[00124] ~~[0246]~~ FIG. 62 is a perspective view of a first beam converter comprised of binary optic elements arranged in parallel and beam conversion by the same.

[00125] ~~[0247]~~ FIG. 63 is a perspective view of a first beam converter comprised of one-dimensional profile refractive index lenses arranged in parallel and beam conversion by the same.

[00126] ~~[0248]~~ FIG. 64 is a perspective view of a first beam converter comprised of semicylindrical profile refractive index lens elements arranged in parallel and beam conversion by the same.

[00127] ~~[0249]~~ FIG. 65 is a perspective view of a beam compressor using an anamorphic prism and beam compression by the same.

[00128] ~~[0250]~~ FIG. 66 is a plan view of the beam compressor shown in FIG. 65 and beam compression using the same.

[00129] ~~[0251]~~ FIG. 67 is a perspective view of a beam compressor using an anamorphic prism pair using two anamorphic prisms and beam compression by the same.

[00130] ~~[0252]~~ FIG. 68 is a plan view of the beam compressor shown in FIG. 67 and beam compression using the same.

[00131] ~~[0253]~~ FIG. 69 is a perspective view of a second beam converter comprised of an optical element having a prism shape and beam conversion by the same.

[00132] ~~[0254]~~ FIG. 70 is a perspective view of an integral second beam converter equivalent to the beam converter of FIG. 69 and beam conversion by the same.

[00133] ~~[0255]~~ FIG. 71 is a perspective view of a second beam converter comprised of mirror elements arranged in parallel and beam conversion by the same.

[00134] ~~[0256]~~ FIG. 72 is a perspective view of a second beam converter comprised of cylindrical lenses arranged in parallel and beam conversion by the same.

[00135] ~~[0257]~~ FIG. 73 is a perspective view of a second beam converter comprised of an optical element having an incidence face and an emission face as cylindrical surfaces and beam conversion by the same.

[00136] ~~[0258]~~ FIG. 74 is a perspective view of a second beam converter fabricated from a block of optical glass and beam conversion by the same.

[00137] ~~[0259]~~ FIG. 75 is a perspective view of a second beam converter comprised of dub prisms arranged in parallel and beam conversion by the same.

[00138] ~~[0260]~~ FIG. 76 is a perspective view of a second beam converter comprised of binary optical elements arranged in parallel and beam conversion by the same.

[00139] ~~[0261]~~ FIG. 77 is a perspective view of a second beam converter comprised of one-dimensional profile refractive index lenses arranged in parallel and beam conversion by the same.

[00140] ~~[0262]~~ FIG. 78 is a perspective view of a second beam converter comprised of semicylindrical profile refractive index lens elements arranged in parallel and beam conversion by the same.

[00141] ~~[0263]~~ FIG. 79 is a view of the generation of protruding components (e.g., escape components) in adjoining elements at the beam emission side.

[00142] ~~[0264]~~ FIG. 80 is a view of a beam converter dividing a cylindrical lens array into two and reducing the radii of curvature of the cylindrical lenses at the beam emission side from the radii of curvature of the cylindrical lenses at the beam incidence side.

[00143] ~~[0265]~~ FIG. 81 is a view of a mode of coupling two laser beams using a polarization element.

[00144] ~~[0266]~~ FIGS. 82A and 82B are views of a mode of coupling two laser beams using a mirror formed with through windows at the same pitch as the stack pitch of the laser diode stack array.

[00145] ~~[0267]~~ FIGS. 83A and 83B are views of a mode of coupling two laser beams using mirrors arranged at the same pitch as the stack pitch of the laser diode stack array.

[00146] ~~[0268]~~ FIGS. 84A and 84B are views of a mode of coupling two laser beams using right angle prisms arranged at the same pitch as the stack pitch of the laser diode stack array.

[00147] ~~[0269]~~ FIG. 85 is a view of the mode of wavelength coupling at least two laser beam groups entering a third condenser.

DETAILED DESCRIPTION~~ OF THE PREFERRED EMBODIMENTS~~

[00148] ~~[0270] The fact~~**It has been described herein** that a laser diode stack array is hard to focus since the divergence angles of the beams differ between the fast axis and the slow axis~~ was explained above. In~~**. According to an exemplary embodiment of** the present invention, the technique ~~is adopted of rotating~~**may be used that rotates** the beams by 90° to enable suitable collimation for each axis. ~~Due to this~~**Using such technique**, it is possible to first collimate the large dispersion fast axis and later slowly and stably independently collimate the small dispersion slow axis.

[00149] ~~[0271] ~~Further, the laser diode stack array ~~forms~~**may form** a planar light source comprised of a plurality of light sources having parallel optical axes arranged on the same plane.

[00150] ~~[0272] ~~FIG. 3 shows the state of parallel beams entering a condensing lens having a focal length f. For simplification, the case of two parallel beams is shown. In ~~this~~**such** case, all beams are condensed at the focal point of the lens and a single image is obtained on the center axis.

~~[0273] On the other hand, when beams having parallel optical axes, but divergence angles enter the condensing lens, the image moves to the far side from the focal point of the lens due to the divergence angles, so separate images are formed at positions off from the center axis of the lens.~~

[00151] ~~[0274] ~~**On the other hand, when beams having parallel optical axes, but divergence angles enter the condensing lens, the image moves to the far side from the focal point of the lens due to the divergence angles, so separate images are formed at positions**

off from the center axis of the lens. This state is shown in FIG. 4. For ~~simplification~~**the purpose of simplicity**, the case of two beams is schematically shown using candles. ~~The fact is that beams~~**Beams** emitted from different objects placed at a finite distance geometrically form different images. The laser diode stack array corresponds to the ~~case~~**arrangement** of FIG. 4. With images formed at separate image points in this way, no augmentation of the light intensity ~~can~~**would likely** be obtained**,** and it is **likely** not possible to concentrate high level energy at a narrow region.

[00152] ~~[0275] Regarding this situation, one of the inventors of the present invention intensively studied~~**Research has been conducted regarding** beams **being** emitted from a plurality of optical fibers**,** and ~~disclosed his~~**the** findings **described** in Japanese ~~Unexamined~~ Patent Publication ~~(Kokai)~~ No. ~~2001-255491. Its gist is roughly speaking summarized in the~~ **2001-255491, the entire disclosure of which is incorporated herein by reference. The** following two methods **have been described in the above-identified publication**.

[00153] ~~[0276] That is, one comprises giving all~~**(i) All** beams **are given** predetermined angles to make it appear as if they were emitted from the same light source when seen from the condensing lens. ~~That is~~**In particular**, as shown in FIG. 5, angles are given so that the beams are emitted from a common imaginary object O placed on the center axis of the lens. **FIG. 5 shows the case of two beams for the purpose of simplicity. An effective caliber of the condensing lens should be made larger to match the opening of the angle between the beams. This technique can be used for light sources with limited divergence angles such as lasers.**

~~[0277] FIG. 5 shows the case of two beams for simplification. It is necessary to make the effective caliber of the condensing lens larger to match the opening of the angle between the beams. This technique is possible for light sources with limited divergence angles such as lasers.~~

[00154] ~~[0278] The other comprises performing an~~**(ii) An** operation **is performed** for reducing the distance between center axes of the beams and, in accordance with need, ~~reducing and reforming~~ an image **is reduced and reformed** so as to form the image small as a whole. That is, as shown in FIG. 6, the distance between center axes of beams having equal intensity profiles is narrowed to make the distance between objects smaller and, as needed, the image is reformed. FIG. 6 shows the case of two beams for ~~simplification~~**the purpose of simplicity**.

[00155] ~~[0279] Note~~**It should be noted** that combining the above two methods ~~is~~**can be** more effective.

[00156] ~~[0280]~~ In the case of the above optical fiber, it is possible to tightly bundle a plurality of fibers to reduce the distance between objects in advance. The method of the above**-identified** Japanese ~~Unexamined Patent Publication (Kokai) No. 2001-255491 works~~**may work** effectively. However, with a laser diode stack array, changing the width of the array or the stack intervals ~~is~~**may be** difficult.

[00157] ~~[0281]~~ Therefore, ~~the inventors further intensively studied~~ methods for combining as much as possible a plurality of objects separated in distance **have been reviewed**. As a result, ~~they discovered~~ various ~~specific~~ methods such as **the** introduction of a compressor~~.~~ **have been uncovered.**

~~[0282] Below, the gist of the present invention will be explained in more detail based on the attached drawings.~~

~~[0283] FIG. 7 is a plan view of an embodiment of a semiconductor laser device of the present invention, while FIG. 8 is an elevation view of the same. Note that the terms "semiconductor laser" and "laser diode" are synonymous.~~

[00158] ~~[0284]~~ **FIG. 7 is a plan view of an exemplary embodiment of a semiconductor laser device according to the present invention, and FIG. 8 is an elevation view of the same. It should be noted that the terms "semiconductor laser" and "laser diode" amay be used synonymously herein.** The semiconductor laser stack array 10 ~~is~~**of FIG. 7 may be** comprised of semiconductor laser linear arrays, each comprised of 10 to 100 ~~(in FIG. 7, for convenience, six)~~ active layer stripes 12 emitting laser beams **(in FIG. 7, for the sake of convenience, the number thereof is six)** arranged in a row in a width of about 10 mm, stacked in parallel (in FIG. 8, four layers shown) to a height of 5 mm to 40 mm.

[00159] ~~[0285]~~ The cross-section of each active layer stripe 12 has for example a width of 100 μm to 200 μm and a thickness of 0.1 μm to 1/5 μm. The laser beams emitted from the end faces of the active layer stripes have emission angles in the thickness direction (hereinafter ~~called the~~**referred to as a** "slow axis direction") of 40° to 50° and emission angles in the width direction (hereinafter ~~called the~~**referred to as a** "fast axis direction") of 10° and form the emission light sources of the semiconductor laser stack array 10.

~~[0286] The active layer stripes are arranged in a row at the end of each semiconductor laser linear array, so the semiconductor laser stack array provides a light source for light emission comprised of line segments arranged in a two-dimensional array.~~

[00160] ~~[0287]~~ **The active layer stripes are arranged in a row at the end of each semiconductor laser linear array, so the semiconductor laser stack array provides a light source for light emission comprised of line segments arranged in a two-dimensional array.** A first cylindrical lens array 20 has the ability to bundle the laser beams emitted from the semiconductor laser stack array 10 in the direction of the thicknesses of the active layer stripes and makes the fast axis components parallel. The first cylindrical lens array 20 has an equal optical thickness equal in the width direction. The beams proceed substantially straight, so the emission angles of the slow axis components of the laser beams remains unchanged at about 10°.

~~[0288] The first beam converter 30 rotates the cross-section of the laser beam outputs from the first cylindrical lens array 20 about 90° from the incident beams. The first beam converter 30 arranges optical elements in a one-to-one correspondence with the active layers of the semiconductor laser stack array 10 in a two-dimensional array so as to correspond to the active layer stripes.~~

[00161] ~~[0289]~~ **The first beam converter 30 rotates the cross-section of the laser beam outputs from the first cylindrical lens array 20 about 90° from the incident beams. The first beam converter 30 arranges optical elements in a one-to-one correspondence with the active layers of the semiconductor laser stack array 10 in a two-dimensional array so as to correspond to the active layer stripes.** The laser beams emitted by the first cylindrical lens array 20 in the width direction by an angle of about 10° and now forming parallel beams in the

thickness direction (see FIG. 8) are rotated about 90° for each active layer stripe by the first beam converter 30, so are converted to beams having emission angles of about 10° in the thickness direction and parallel in the width direction (see FIG. 7). Note that the optical element can be designed to handle a group of stripes including a plurality of active layer stripes.

[00162] ~~[0290]~~ Since laser beams rotated about 90° for beam conversion are aligned in parallel in exactly the number of the active layer stripes or stripe groups, the emission beams of the semiconductor laser stack array 10 are arranged in parallel in a ladder rung configuration. This parallel arrangement becomes substantially the same as one with a further plurality arranged in parallel to form a two-dimensional array. The next collimation can be easily realized by this rotation.

[00163] ~~[0291]~~ The second cylindrical lens array 80 bends and collimates the group of laser beams in the thickness direction for each row. At the same time, by offsetting the center axes of the lens and beams by exactly predetermined amounts for use, angular change of the optical axes is caused for conversion to a group of beams emitted from approximately the same object.

~~[0292] The beam compressor 40 shortens the intervals of the ladder rungs of laser beams arranged in parallel in a ladder rung configuration to compress the laser beams. Such compressed laser beams are further aligned linearly in one row in the height direction (stack direction) of the semiconductor laser stack array.~~

[00164] ~~[0293]~~ **The beam compressor 40 shortens the intervals of the ladder rungs of laser beams arranged in parallel in a ladder rung configuration to compress the laser beams. Such compressed laser beams are further aligned linearly in one row in the height direction (stack direction) of the semiconductor laser stack array.** The compressed group of beams are

narrow in intervals of the ladder rungs, so during propagation, there is overlap in the intensity profile and the beams no longer appear to be separate. That is, the beams emitted from the semiconductor laser stack array become a single group of beams for each array at the exit of the beam compressor 40.

[00165] ~~[0294]~~ Further, the condensing lens 70 condenses all of the group of beams. The group of beams become approximately beams emitted from the same object on the center axis of the condensing lens 70, so form an image on the same spot on the center axis. The size of the condensed spot becomes a size of an extent of the collimated beam diameters for each direction multiplied with the imaging ratio of the condensing lens 70 when deeming those diameters as the size of the objects.

~~[0295] However, the size of a object at the fast axis direction has to be deemed the beam size for slow axis direction at the beam compressor multiplied with the compression ratio of the beam compressor 40.~~

[00166] ~~[0296]~~ **However, the size of a object at the fast axis direction is preferably deemed the beam size for slow axis direction at the beam compressor multiplied with the compression ratio of the beam compressor 40.** For example, when the beam size for slow axis direction is 10 mm and the compression ratio of the beam compressor 40 is 1/10, the size of the object on the fast axis direction is considered to be 1 mm. Therefore, if making the imaging ratio of the condensing lens 70 1/3, the size of the image becomes about 330 μm. Strictly speaking, line segment shaped images are arranged at equal intervals in it.

~~[0297] Regarding the slow axis direction, if the collimated diameter due to the second cylindrical lens array 80 is 400~~ **Regarding the slow axis direction, if the collimated diameter due to the second cylindrical lens array 80 is 400** μ~~m, the image becomes 133~~**m, the image becomes 133** μ~~m. As a result, a spot of 330~~**m. As a result, a spot of 330** μ~~m~~ **m** × ~~133~~ **133** μ~~m is obtained. A power density of 2 MW/cm² is obtained by an output of 1 kW. This is a sufficient power density for deep penetration welding of metal.~~**m is obtained. A power density of 2 MW/cm² is obtained by an output of 1 kW. This is a sufficient power density for deep penetration welding of metal.**

[00167] ~~[0298]~~ If not allowing an angular change by the second cylindrical lens array 80, the group of beams from the array ~~will form~~**forms** separate images, so the size of the overall image for the slow axis direction will become a size of the height of the stack multiplied with the imaging ratio of the condensing lens 70. For example, if the stack height is 30 mm, the size of the total image will become 10 mm. In this way, it is possible to superpose discrete images at one spot by an angular change.

[00168] ~~[0299] Note that the~~**The** second cylindrical lens array 80 may be arranged in front of the first beam converter 30 as shown in FIG. 7 and FIG. 8 or may be arranged in front of the beam compressor 40. At that time, the first beam converter 30 and second cylindrical lens array 80 or the second cylindrical lens array 80 and beam compressor 40 can be made integral. ~~Due to this~~**Thus**, there is the advantage that the number of parts can be reduced and the loss at the interface is reduced.

[00169] ~~[0300]~~ FIG. 9 is a plan view of a semiconductor laser device of the present invention in the case of using such a quasi-continuous wave laser diode (**e.g., a** quasi-CW-LD) with a high density of light emitter as the laser diode stack array, while FIG. 10 is an elevation view. The laser diode stack array 10 is provided with a large number of active layer stripes 12 at a high density and forms a linear emitter with substantially no breaks.

[00170] ~~[0301]~~ The first beam converter 30 ~~is~~**may be** comprised of a linearly aligned suitable number of optical elements either having no relation with the size of the active layer stripes or having dimensions corresponding to a predetermined number of stripes. The positions and actions of the first cylindrical lens array 20, the first beam converter 30, the beam compressor 40, the second cylindrical lens array 80, and the condensing lens 70 are **substantially** the same as those ~~explained in~~**described with reference to** FIG. 7 and FIG. 8.

[00171] ~~[0302]~~ When using laser diodes with short widths of the active layer stripes or narrow intervals of the same in this way, fabrication of a beam converter becomes difficult if providing the optical elements of the first beam converter in a one-to-one correspondence with the active layer stripes.

~~[0303]~~ This mode instead ~~groups~~**can group** a suitable number of active layer stripes together and provides the elements in correspondence with them. Further, instead of viewing the emission parts of the laser diodes as a broken line, it may also be considered to deem them as a single stripe, divide it into suitable sections by optical elements, and rotate the same so as to change them to laser diodes emitting light in a de facto ladder rung configuration.

[00172] ~~[0304]~~ FIG. 11 is a plan view of another **exemplary** embodiment of a semiconductor laser device ~~of~~**according to** the present invention, ~~while~~**and** FIG. 12 is an elevation view of the same. The point of difference from the example shown in FIG. 7 and FIG. 8 is that the means for changing the beam angles is not the second cylindrical lens array 80, but newly separately provided transparent wedge plates 120. The second cylindrical lens array 80 handles only the action of collimating the slow axis components.

[00173] ~~[0305]~~ The transparent wedge plates 120 are transparent plates with angles as shown in FIG. 12. Beams are given an angular change due to refraction when passing through the same. The position of provision of the transparent wedge plates 120, as shown in FIG. 11 and FIG. 12, may be in front of the beam compressor 40 or between the second cylindrical lens array 80 and the beam compressor 40. At this time, it is also possible to make the transparent wedge plates 120 and second cylindrical lens array 80 or beam compressor 40 integral. **Accordingly, there are the advantages that the number of parts can be slashed and the loss at the interface is reduced. This exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.**

~~[0306] Due to this, there are the advantages that the number of parts can be slashed and the loss at the interface is reduced. This embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

[00174] ~~[0307]~~ Further, it is also possible to omit the second cylindrical lens array as shown in FIG. 13 and FIG. 14. Note that FIG. 13 and FIG. 14 show an example where the first beam converter 30 and transparent wedge plates are made integral. Further, the present **exemplary**

embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.

[00175] ~~[0308]~~ FIG. 15 is a plan view of another **exemplary** embodiment of the semiconductor laser device of the present invention, while FIG. 16 is an elevation view. The ~~point of~~ difference from the example shown in FIG. 7 and FIG. 8 is that the means for changing the beam angles is not the second cylindrical lens array 80, but newly separately provided cylindrical lenses 130. The second cylindrical lens array 80 **likely** handles only the action of collimating the slow axis components.

[00176] ~~[0309]~~ The cylindrical lenses 130, as shown in FIG. 16, are lenses acting in the stack direction of the stack array (second direction) and create angular changes by use offset in center axis. The cylindrical lenses 130, as shown in FIG. 16, are arranged in front of the beam compressor 40 or are arranged between the second cylindrical lens array 80 and the beam compressor 40. At that time, it is also possible to make the cylindrical lenses and beam compressor 40 integral. **Further, the second cylindrical lens array 80 may also be omitted. Further, the present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.**

~~[0310] Further, the second cylindrical lens array 80 may also be omitted. Further, the present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

[00177] ~~[0311]~~ FIG. 17 is a plan view of another **exemplary** embodiment of the semiconductor laser device ~~of~~**according to** the present invention, ~~while~~**and** FIG. 18 is an elevation view. The

~~point of~~ difference from the example shown in FIG. 7 and FIG. 8 is that the beam angles are not changed, but rather the method is adopted of narrowing the distance between center axes of the beams. Therefore, a second condensing lens 71 having a focal length f3 is provided after the second cylindrical lens array 80.

~~[0312] The slow axis components of the group of beams emitted from the laser diode stack array are collimated by the second cylindrical lens array 80 having the focal length f2, but spread during propagation due to the nature of waves and therefore become somewhat divergent beams before the second condensing lens. However, the center axes are~~ **The slow axis components of the group of beams emitted from the laser diode stack array are collimated by the second cylindrical lens array 80 having the focal length f2, but spread during propagation due to the nature of waves and therefore become somewhat divergent beams before the second condensing lens. However, the center axes are approximately** parallel.

[00178] ~~[0313]~~ Therefore, if concentrating these by the second condensing lens, ~~strictly speaking as explained in~~**as indicated above with reference to** FIG. 4, discrete images ~~are~~**can be** formed. ~~That is~~**For example**, after the second cylindrical lens array 80, ~~more precisely it should be thought that~~ the object ~~moves~~**canbe thought of as moving** to a position where the wave front becomes flat. However, since the divergence angles are small, the offset distances of the images from the center axis of the second condensing lens 70 are extremely small and the images appear superposed ~~almost completely.~~**, e.g., almost completely. The same may apply to the fast axis components. The object can be formed right after the first cylindrical lens array 20. If the images are concentrated using the second condensing lens 70, again discrete images may be**

formed. However, since the distance between images is still shorter compared with the slow axis components, the overall intensity profile may become an almost completely single peak type.

~~[0314] The same applies to the fast axis components. The object is formed right after the first cylindrical lens array 20. If concentrating them by the second condensing lens 70, again strictly speaking discrete images are formed. However, since the distance between images is still shorter compared with the slow axis components, the overall intensity profile becomes an almost completely single peak type.~~

[00179] ~~[0315]~~ In this ~~way~~**manner**, at the image-forming plane of the second condensing lens 70, a single peak type image is obtained in both directions. However, an enlarged imaging system is formed with a magnification of the image of f3/f1 in the fast axis direction and f3/f2 in the slow axis direction, so the image may become larger.

[00180] ~~[0316]~~ FIGS. 19A to 19C schematically illustrate the above ~~explanation~~**description** in a manner tracking the object for the configuration of FIG. 17 and FIG. 18. **The illustration of** FIG. 19A ~~looks at~~**shows** the output beams of the laser diode stack array from the front. For ~~simplification,~~**the purpose of simplicity, a** part is taken to show six stripes per array and four stack layers (note that the total width is 10 mm and the actual number of stripes is greater than six).

[00181] ~~[0317] FIG. 19B shows the cross sectional view of the beams after the first beam converter, while FIG. 19C shows the image formed by the second condensing lens. Next, concrete numerical figures will~~**FIG. 19B shows the cross sectional view of the beams after the**

first beam converter, and FIG. 19C shows the image formed by the second condensing lens. Next, concrete numerical figures are discussed to explain the state of image formation. For example, it may be ~~given to explain the state of image formation. For example, assume that the emission diameter of the fast axis components is 1~~ **assumed that the emission diameter of the fast axis components is 1** μm, ~~while the emission diameter of the slow axis components is 200 m.~~ **m, while the emission diameter of the slow axis components is 200** ~~μm.~~

~~[0318]~~ ~~If the focal length f1 of the first cylindrical lens array 20 is 0.3 mm, the focal length f2 of the second cylindrical lens array 80 is 4.5 mm, and the focal length f3 of the condensing lens 71 is 30 mm, an image of a size of about 1~~ **m. If the focal length f1 of the first cylindrical lens array 20 is 0.3 mm, the focal length f2 of the second cylindrical lens array 80 is 4.5 mm, and the focal length f3 of the condensing lens 71 is 30 mm, an image of a size of about 1** ~~μm~~ **m** × ~~30/0.3 = 100~~ **30/0.3 = 100** ~~μm in the original array direction and about 200~~ **m in the original array direction and about 200** ~~μm~~ **m** × ~~30/4.5 = 1.3 mm in the stack direction of the stack array is obtained.~~

~~[0319]~~ **30/4.5 = 1.3 mm in the stack direction of the stack array is obtained.** However, in practice, there ~~is~~**may be a** mounting error**,** etc. in the emitters and optical system, so the condensing diameter in the array direction sometimes becomes about double the above or about 200 μm. If the output at this time is 50W, the power density becomes about 2×10^4 W/cm^2. The spot is oval. The present **exemplary** embodiment **of the present invention** can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.

[00182] ~~[0320]~~ FIG. 20 is a plan view of another **exemplary** embodiment of the semiconductor laser device ~~of~~**according to** the present invention, ~~while~~**and** FIG. 21 is an elevation view **thereof**. The present **exemplary** embodiment **can** further ~~reduces~~**reduce** the image from the embodiment shown in FIG. 17 and FIG. 18 to narrow the distance between center axes of the beams. Therefore, a condenser 70 ~~is~~**may be** provided after the condenser 71. **A further higher power density can be realized from the example shown in FIG. 17 and FIG. 18. The present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.**

~~[0321] A further higher power density can be realized from the example shown in FIG. 17 and FIG. 18. The present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

~~[0322] FIG. 22 is a side view explaining a configuration providing the embodiment shown in FIG. 20 and FIG. 21 with an optical axis angle changing function near the focal point of the second condensing lens for the stack direction and forming an image by the condensing lens 70.~~

~~[0323] As the optical axis angle changing element, transparent wedge plates 120 are used. Near the focal point, each beam forms an image, so the beams are clearly separated. Therefore, by providing the transparent wedge plates there, it is possible to convert all of the beams to a beam appearing to be emitted from a common object.~~

[00183] ~~[0324]~~ **FIG. 22 is a side view explaining a configuration providing the exemplary embodiment shown in FIG. 20 and FIG. 21 with an optical axis angle changing function near the focal point of the second condensing lens for the stack direction and forming an**

image by the condensing lens 70. As the optical axis angle changing element, transparent wedge plates 120 are used. Near the focal point, each beam forms an image, so the beams are clearly separated. Therefore, by providing the transparent wedge plates there, it is possible to convert all of the beams to a beam appearing to be emitted from a common object. As a result, the images in the stack direction match at the image-forming point of the condensing lens. This effect can be similarly obtained in the array direction as well. Further, it is also possible to change the angle of several beams together. Note that it is also possible to use a cylindrical lens to obtain the optical axis angle changing function. **The present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.**

~~[0325] The present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

[00184] ~~[0326]~~ FIG. 23 is a perspective view of **still** another **exemplary** embodiment of a semiconductor laser device ~~of~~**according to** the present invention. The present **exemplary** embodiment uses as ~~the means~~**an arrangement** for reducing the distance between center axes of the beams two one-dimensional telescopes using parabolic mirrors. For this **purpose**, four cylindrical parabolic mirrors are set after the second cylindrical lens array 80. In this example, the compression of the semiconductor laser stack array in the array direction and the compression in the stack direction are functionally separated. **The first cylindrical parabolic mirror 110 and the second cylindrical parabolic mirror 111 configure the array direction compression telescope, while the third cylindrical parabolic mirror 112 and the fourth cylindrical**

parabolic mirror 113 configure the stack direction compression telescope. The telescopes may be the Kepler type or the Galileo type. In either case, a new object is formed at the exit side of the telescope. The telescopes may also be configured by cylindrical lenses. It is also possible to use a combination of cylindrical parabolic mirrors and cylindrical lenses. To correct the increase in divergence angles due to the beam compression, a cylindrical lens 60 may be provided. The present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.

~~[0327] The first cylindrical parabolic mirror 110 and the second cylindrical parabolic mirror 111 configure the array direction compression telescope, while the third cylindrical parabolic mirror 112 and the fourth cylindrical parabolic mirror 113 configure the stack direction compression telescope.~~

~~[0328] The telescopes may be the Kepler type or the Galileo type. In either case, a new object is formed at the exit side of the telescope. Note that the telescopes may also be configured by cylindrical lenses. Of course, it is also possible to use a combination of cylindrical parabolic mirrors and cylindrical lenses. To correct the increase in divergence angles due to the beam compression, a cylindrical lens 60 may be provided.~~

~~[0329] The present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

[00185] ~~[0330]~~ FIG. 24 is a perspective view explaining a configuration using as the telescopes in the **exemplary** embodiment shown in FIG. 23 ~~ones~~ using cylindrical lenses, ~~in particular~~**and for example** using a Kepler type for the stack direction, and further providing an optical axis

angle changing element at the focal point or its vicinity and combining the images. As the optical axis angle changing element, transparent wedge plates 120 are used. FIG. 25 is an enlarged view of part of this exemplary effect. For example, near the focal point, the beams form images, so the beams are clearly separated. By arranging the transparent wedge plates 120 there, it is possible to convert all of the beams to appear to be a beam emitted from a common object. As a result, at the image-forming point of the condensing lens 70, the images for stack direction coincide. FIG. 26 shows this exemplary state. At the image-forming point, the distance between optical axes of the beam is narrow, so there are the advantages that the wedge plate angle can be made small and the effective aperture of the condensing lens 70 can be made small. The effect of this exemplary embodiment can be similarly obtained in the array direction as well. It is also possible to use a cylindrical lens to obtain the optical axis angle changing function. The present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.

~~[0331] FIG. 25 is an enlarged view of part of this. Near the focal point, the beams form images, so the beams are clearly separated. By arranging the transparent wedge plates 120 there, it is possible to convert all of the beams to appear to be a beam emitted from a common object.~~

~~[0332] As a result, at the image-forming point of the condensing lens 70, the images for stack direction coincide. FIG. 26 shows this state. At the image-forming point, the distance between optical axes of the beam is narrow, so there are the advantages that the wedge plate angle can be made small and the effective aperture of the condensing lens 70 can be made small.~~

~~[0333] The effect of this embodiment can be similarly obtained in the array direction as well. It is also possible to use a cylindrical lens to obtain the optical axis angle changing function.~~

~~[0334] The present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

~~[0335] FIG. 27 is a plan view of another embodiment of the semiconductor laser device of the present invention, while FIG. 28 is an elevation view of the same. This embodiment uses telescopes as the means for reducing the distances between center axes of the beams. Therefore, the lens 141 is provided after the lens 140. The lens 140 and the lens 141 configure a Kepler type telescope. Of course, it is also possible to make the lens 141 a concave lens and make the telescope a Galileo type. Whatever the case, the wave front becomes flat in the vicinity of exit side of the lens 141, so a new object is formed there.~~

[00186] ~~[0336]~~ **FIG. 27 is a plan view of yet another exemplary embodiment of the semiconductor laser device according to the present invention, and FIG. 28 is an elevation view of the same. This exemplary embodiment uses telescopes as an arrangement for reducing the distances between center axes of the beams. Therefore, the lens 141 is provided after the lens 140. The lens 140 and the lens 141 configure a Kepler type telescope. It is also possible to make the lens 141 a concave lens and make the telescope a Galileo type. The wave front may become flat in the vicinity of exit side of the lens 141, so a new object is formed there.** First, the state of the beams at the telescope exit side will be explained. If the stack distance is made 1.75 mm, the number of layers 20, the stripe distance 800 μm, the collimate diameter at the fast axis side by the first cylindrical lens array 20 200 μm,

the collimated diameter for the slow axis direction by the second cylindrical lens array 80 400 μm, and the reduction ratio of the telescope 1/10, then 12 stripe images will be arranged in a ladder rung configuration at intervals of about 80 μm in a total width of about 14 mm in the original array direction.

~~[0337]~~ ~~In the original array direction, the beam diameter of a single beam is about 20~~ **In the original array direction, the beam diameter of a single beam is about 20** μm~~, so the overall images become discrete. On the other hand, four groups of beams are arranged at intervals of about 175~~**m, so the overall images become discrete. On the other hand, four groups of beams are arranged at intervals of about 175** μm ~~in the stack direction of the stack array. In this direction, the beam diameter of a single beam is about 40~~**m in the stack direction of the stack array. In this direction, the beam diameter of a single beam is about 40** μm~~, so the images become even more discrete compared with the original array direction.~~**m, so the images become even more discrete compared with the original array direction.**

~~[0338]~~ ~~Two-dimensionally, the result is an image with line segments arranged in a rectangle of about 3.3 mm in the stack direction. FIGS. 29A and 29B illustrate the state of change of the image before and after the telescope. In these figures, for convenience, four stack layers of six stripes each are shown.~~

[00187] ~~[0339]~~ **Two-dimensionally, the result is an image with line segments arranged in a rectangle of about 3.3 mm in the stack direction. FIGS. 29A and 29B illustrate the state of change of the image before and after the telescope. In these figures, for the sake of convenience, four stack layers of six stripes each are shown.** Next, the first condensing lens

70 is used to again reduce the above object and form an image so as to form an image appearing sufficient for practical use. The reduction ratio is made 1/4, so 12 stripes are arranged in a ladder rung configuration at distances of about 20 μm in a total width of about 250 μm in the original array direction.

~~[0340]~~ ~~On the other hand, for the stack direction of the stack array, 20 groups of beams are arranged at intervals of about 44~~ **For the stack direction of the stack array, 20 groups of beams are arranged at intervals of about 44** ~~μm in a total width of about 830~~**m in a total width of about 830** ~~μm. That is, two dimensionally, the result is an overall image of line segments arranged in a rectangle of 250~~**m. In particular, two dimensionally, the result is an overall image of line segments arranged in a rectangle of 250** ~~μm in the array direction and 830~~**m in the array direction and 830** ~~μm in the stack direction.~~**m in the stack direction.**

[00188] ~~[0341] If making this that small~~**If such reduction is achieved**, however, even if used for materials processing, ~~considering~~ the heat transfer and dispersion at the workpiece side **should be considered**, whether or not the image is uniform is no longer than much of a problem. For example, if the output at the condensing point is 500W, the average power density of the overall image becomes 2.4×10^5 W/cm² - which is sufficient for materials processing such as deep penetration welding of metals. **As a way for reducing the distance between center axes of the beams, it is also possible to use a telescope using a parabolic mirror. Further, the present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.**

~~[0342] Note that as the means for reducing the distance between center axes of the beams, it is also possible to use a telescope using a parabolic mirror. Further, the present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

~~[0343] FIG. 30 is a perspective view of an example of a configuration comprised of the embodiment shown in FIG. 23 plus a second beam converter 50 between the array direction telescope and stack direction (second direction) telescope.~~

~~[0344] The second beam converter 50 rotates the group of beams for each array to convert it to a single row ladder rung configuration. Along with this operation, what are compressed by the second telescope constituted by the stack direction telescope are the fast axis components.~~

[00189] ~~[0345]~~ **FIG. 30 is a perspective view of an example of a configuration comprised of the embodiment shown in FIG. 23, as well as a second beam converter 50 between the array direction telescope and stack direction (second direction) telescope. The second beam converter 50 rotates the group of beams for each array to convert it to a single row ladder rung configuration. Along with this operation, the fast axis components are compressed by the second telescope constituted by the stack direction telescope.** Therefore, together with the first telescope constituted by the array direction telescope, the fast axis components are compressed twice. The second beam converter (50) preferably is struck by the beams of each stack bar at its beam conversion elements. The stack beams may also strike it after being superposed. In this case, the beam is divided and rotated for each beam conversion element of the second beam converter.

[00190] ~~[0346] However, in~~In the example of the configuration shown in FIG. 30, when the laser beams passing through the first beam compressor (110, 111) are beams having some divergence angles in the fast axis direction, when the laser beams pass through the second beam converter (50), they protrude out to the adjoining beam conversion elements and, as shown in FIG. 31, form ghosts. As a result, the thruput of the beams is reduced. **Therefore, as shown in FIG. 32, it may be preferable to provide between the first beam compressor (110, 111) and second beam converter (50) a cylindrical lens (fifth condenser (154)) for bending and collimating the laser beams of each row passing through the first beam compressor (110, 111) in a first direction (slow axis direction). By provision of the fifth condenser (154), the envelope line of the group of laser beams passing through the second beam converter (50) becomes narrower and the ghosts disappear.**

~~[0347] Therefore, as shown in FIG. 32, it is preferable to provide between the first beam compressor (110, 111) and second beam converter (50) a cylindrical lens (fifth condenser (154)) for bending and collimating the laser beams of each row passing through the first beam compressor (110, 111) in a first direction (slow axis direction).~~

~~[0348] By provision of the fifth condenser (154), the envelope line of the group of laser beams passing through the second beam converter (50) becomes narrower and the ghosts disappear.~~

[00191] ~~[0349] Note that one~~One of the properties of light is the constant nature of the product D·θ of beam diameter D and divergence angle θ. The smaller the product, the better the condensability. Further, if the fast axis component is one where $D_F = 1$ μm and $\theta_F = 0.698$ rad

and the slow axis component is one where D_S = 200 μm and θ_S = 0.175 rad, then $D_F \cdot \theta_F$ = 0.7 μm·rad and $D_S \cdot \theta_S$ = 35 μm·rad, so there is a 50-fold gap in the size of the products. In this way, the slow axis component is better in condensability, so compressing the fast axis component twice is advantageous.

~~[0350] Conversely, the beam divergence angle is increased by the amount of compression, so there is a concern that the overall beam diameter of the striking the condensing lens will become larger. Therefore, the cylindrical lens 60 is arranged to close the gap of divergence between the array direction and the stack direction.~~

~~[0351]~~ ~~The present~~ **Conversely, the beam divergence angle is increased by the amount of compression, so there is a concern that the overall beam diameter of the striking the condensing lens will become larger. Therefore, the cylindrical lens 60 is arranged to close the gap of divergence between the array direction and the stack direction. The present exemplary** embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.

[00192] ~~[0352]~~ FIG. 33 is a perspective view of another **exemplary** embodiment of the present invention in which the arrangement of FIG. 30 is augmented by stack direction and array direction transparent wedge plates (120, 121). ~~The~~**This** figure shows ~~the case of dividing~~**that** the group of beams **is divided** into three to change the direction in the stack direction and the array direction.

~~[0353] Further, FIG. 34 shows another embodiment comprised of the embodiment shown in FIG. 33 wherein the first beam compressor (110, 111) and the second beam converter (50 have a cylindrical lens (first condenser (154)) provided between them.~~

[00193] ~~[0354]~~ **Further, FIG. 34 shows another exemplary embodiment comprised of the embodiment shown in FIG. 33 wherein the first beam compressor (110, 111) and the second beam converter (50 have a cylindrical lens (first condenser (154)) provided between them.** The group of beams is divided into three in the stack direction and the array direction, then the beams are superposed at the image-forming point of the condensing lens 70. That is, in each embodiment, compared with the method shown in FIG. 30, the spot diameter becomes about 1/3. Further, instead of the transparent wedge plates, it is also possible to use a beam compressor.

[00194] ~~[0355] The present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

~~[0356] FIG. 35 is a view for explaining~~**The present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks. FIG. 35 is a view illustrating** an optical axis shift using a beam shifter. As the beam shifter, it is possible to use transparent parallel plates. The principle of optical axis shift is based on the law of refraction. When light passes through transparent parallel plates having a refractive index n and thickness t, the optical axis is shifted in parallel according to the refractive index n and thickness t and the incidence angle θ.

~~[0357] The shift r is expressed by the equation r = t·sin(~~ **The shift r is expressed by the equation r = t·sin(**θ-**-**φ~~)/cos(~~**)/cos(**φ), ~~where~~ **), where** φ ~~= sin^-1^(sin(~~ **= sin^-1^(sin(**θ~~)/n). If arranging~~

~~the beam shifter in advance of the first beam converter 30 to adjust the incidence angle, it is possible to adjust the beam optical axes at the center of the aperture of the first beam converter 30.~~)/n). **If arranging the beam shifter in advance of the first beam converter 30 to adjust the incidence angle, it is possible to adjust the beam optical axes at the center of the aperture of the first beam converter 30. Further, by arranging it in advance of the second cylindrical lens array 80 to adjust the angle, it is possible to adjust the beam optical axes at the center of the aperture of the second cylindrical lens array 80. Further, if changing the positions of the beams striking the second cylindrical lens array 80 by this, it is possible to give an angular change to the beams.**

~~[0358] Further, by arranging it in advance of the second cylindrical lens array 80 to adjust the angle, it is possible to adjust the beam optical axes at the center of the aperture of the second cylindrical lens array 80. Further, if changing the positions of the beams striking the second cylindrical lens array 80 by this, it is possible to give an angular change to the beams.~~

~~[0359] FIG. 36 is a perspective view of another embodiment of the present invention comprised of the arrangement of FIG. 30 from which one beam converter is removed and having the array direction (first direction) and stack direction (second direction) telescopes switched.~~

~~[0360] The first cylindrical lens 20 is used to collimate the fast axis components, then the fast axis components of the entire stack are compressed all together by the second beam compressor (in the figure, comprised by 112 and 113), then the second beam converter 50 is used to indiscriminately divide and rotate the slow axis components.~~

[00195] ~~[0361]~~ **FIG. 36 is a perspective view of still another exemplary embodiment of the present invention comprised of the arrangement of FIG. 30 from which one beam converter**

is removed and having the array direction (first direction) and stack direction (second direction) telescopes switched. The first cylindrical lens 20 is used to collimate the fast axis components, then the fast axis components of the entire stack are compressed all together by the second beam compressor (in the figure, comprised by 112 and 113), then the second beam converter 50 is used to indiscriminately divide and rotate the slow axis components. This state is shown in FIG. 37. The first cylindrical lens array 20 may be used to obtain sufficiently broadened beam diameters close to the stack pitch. The pitch of the second beam converter 50 is made 0.5 mm or so. When emerging from the second beam converter 50, the beams are aligned vertically. Further, the second beam compressor (cylindrical parabolic mirrors) 112, 113 is used to compress the fast axis components in the array direction, the cylindrical lens 60 is used to match the divergence of the fast axis components and slow axis components, then the condensing lens 70 is used for focusing. As the first cylindrical lens array 20, it is possible to use lenses with a relatively long focal length. A clearance up to the emitters of about 1 mm may be taken, so easy alignment becomes possible. The present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.

~~[0362] As the first cylindrical lens array 20, it is possible to use lenses with a relatively long focal length. A clearance up to the emitters of about 1 mm may be taken, so easy alignment becomes possible.~~

~~[0363] The present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

~~[0364] FIG. 38 is a perspective view of another embodiment of the present invention comprised of the arrangement of FIG. 36 augmented by stack direction and array direction transparent wedge plates (120, 121). The figure shows the case of dividing the group of beams into three and changing their directions in the stack direction and array direction.~~

~~[0365] The group of beams is divided into three in the stack direction and the array direction, then the beams are superposed at the image-forming point of the condensing lens 70. That is, compared with the method shown in FIG. 36, the spot diameter becomes about 1/3. Further, instead of the transparent wedge plates (120, 121), it is also possible to use a beam compressor.~~

[00196] ~~[0366]~~ **FIG. 38 is a perspective view of another exemplary embodiment of the present invention comprised of the arrangement of FIG. 36 augmented by stack direction and array direction transparent wedge plates (120, 121). The figure shows the case of dividing the group of beams into three and changing their directions in the stack direction and array direction. The group of beams is divided into three in the stack direction and the array direction, then the beams are superposed at the image-forming point of the condensing lens 70. That is, compared with the method shown in FIG. 36, the spot diameter becomes about 1/3. Further, instead of the transparent wedge plates (120, 121), it is also possible to use a beam compressor.** Further, as shown in FIG. 39, to make the ghosts derived from the divergence angle in the fast axis direction of the laser beams disappear, it is preferable to provide between the second beam compressor (152, 153) and the beam converter (50) a cylindrical lens (fifth condenser (155)) for bending and collimating each row of laser beams passing through the second beam compressor (152, 153). In this case, the beam compressor is comprised of cylindrical lens.

~~[0367]~~ ~~The present~~ **The present exemplary** embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.

[00197] ~~[0368]~~ FIG. 40 is a perspective view of another **exemplary** embodiment of a semiconductor laser device ~~of~~**according to** the present invention. The ~~point of~~ difference from the example shown in FIG. 7 and FIG. 8 is that the ~~means~~**arrangement** for changing the beam angles is not the second cylindrical lens array 80, but a parabolic mirror 111 used as a beam compressor (in the figure, comprised of 110 and 111) with a reflecting face segmented corresponding to the groups of beams. **The present exemplary embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.**

~~[0369] The present embodiment can also be similarly applied to a semiconductor laser stack array having a linear emission part with substantially no breaks.~~

~~[0370] As explained using the embodiments above, the present invention can make the laser energy converge at an extremely small area. To further raise the convergence degree, however, it is necessary to raise the parallelism of the optical axes of the laser beams emitted from the first cylindrical lens array (first condenser).~~

[00198] ~~[0371] That is~~**As explained herein with respect to other exemplary embodiments, the present invention can make the laser energy converge at an extremely small area. To further raise the convergence degree, however, it may be needed to raise the parallelism of the optical axes of the laser beams emitted from the first cylindrical lens array (e.g., a first condenser). In particular**, if there is error of as little as about 1/10000 radian in the mounting of

the first cylindrical lens array (first condenser), the parallelism between optical axes of the laser beams emitted from the laser diode stack array will deteriorate and the beams will end up being condensed at a point different from the scheduled condensing point in some cases.

~~[0372]~~ ~~Due to this, it is~~ **Due to this, it may be** preferable to provide in front of the first cylindrical lens array (first condenser) an angle adjuster able to finely adjust the optical axis angle on the order of 1/10000 radian in the second direction (slow axis direction) for each row.

[00199] ~~[0373]~~ An example of this angle adjuster is shown in FIG. 41. As shown in the figure, two wedge plates (P1 and P2) having predetermined inclination angles (ϕ) are combined in reverse directions. One (P1) is fixed, while one (P2) is rotatable (rotation angle θ). Note that in the figure, the arrows show the optical axes.

~~[0374] With the single rotatable wedge plate, fine adjustment of the optical axis angle of a laser beam on the 1/10000 radian order is not possible, but with the above configuration using two wedge plates, fine adjustment of the optical axis angle on the 1/10000 radian order is possible.~~

~~[0375] FIG. 42 shows the adjustment angles of an optical axis when using wedge plates with inclination angles~~ **With the single rotatable wedge plate, fine adjustment of the optical axis angle of a laser beam on the 1/10000 radian order is not possible, but with the above configuration using two wedge plates, fine adjustment of the optical axis angle on the 1/10000 radian order is possible. FIG. 42 shows the adjustment angles of an optical axis when using wedge plates with inclination angles** ϕ ~~of 1.5°, 3°, and 4.5°, making the incidence angle~~ **of 1.5°, 3°, and 4.5°, making the incidence angle** θ ~~1 to the first wedge plate P1 (fixed) 0,~~

~~making n (refractive index) 1.511, and rotating the second wedge plate P2 (abscissa~~ **1 to the first wedge plate P1 (fixed) 0, making n (refractive index) 1.511, and rotating the second wedge plate P2 (abscissa** θ~~2).~~

~~[0376]~~ ~~When the inclination angle~~ **2). When the inclination angle** ϕ ~~is 3°, the rotation angle~~ **is 3°, the rotation angle** θ~~2 is -10° to 14° and angle adjustment of about 1/1000 radian is possible.~~ **2 is -10° to 14° and angle adjustment of about 1/1000 radian is possible. However, since the polarization directions of the optical axes are the same (for example, only minus side), when using the above angle adjuster, care and ingenuity may be required.**

~~[0377]~~ ~~However, since the polarization directions of the optical axes are the same (for example, only minus side), when using the above angle adjuster, care and ingenuity are required.~~

~~[0378]~~ ~~However, whatever the case, by using the above angle adjuster, it is possible to obtain the effect of the present invention more remarkably.~~

[00200] ~~[0379]~~ **However, whatever the case, by using the above angle adjuster, it is possible to obtain the effect of the present invention more remarkably.** FIG. 51 is a schematic view for explaining the optical system comprised of the first beam converter 30, the beam compressor 40, and the second beam converter 50 of the present invention. The first beam converter 30, as shown in FIG. 51, is formed by linking a suitable number of optical elements 32 in a two-dimensional array. The width and height of the first beam converter correspond to the emission face of the laser diode stack array. **The optical elements 32, as shown in FIG. 51, have light receiving faces for receiving light face-perpendicular to the laser beams 36 having axial directions of the active layer stripes in the width direction of the first beam converter and**

output faces for outputting face-vertically the laser beams 37 processed to twist in their optical paths along the optical axes in the optical elements and be converted in optical paths.

~~[0380] The optical elements 32, as shown in FIG. 51, have light receiving faces for receiving light face-perpendicular to the laser beams 36 having axial directions of the active layer stripes in the width direction of the first beam converter and output faces for outputting face-vertically the laser beams 37 processed to twist in their optical paths along the optical axes in the optical elements and be converted in optical paths.~~

[00201] ~~[0381]~~ The optical elements 32 for example horizontally receive laser beams 36 having directions of the long axes of the stripes emitted from the active layer stripes arranged at intervals of 800 μm and rotate the orientations of the cross-sections of the received laser beams about 90° to convert the beams so that the stripe axial directions become vertical.

~~[0382] The optical elements 32 used for the first beam converter 30 generally are provided in a one-to-one correspondence with the active layer stripes 12 of the laser diode stack array 10 used for a laser device incorporating the first beam converter.~~

~~[0383] Therefore, when for example using a laser diode stack array comprised of 20 arrays each comprised of 12 active layer stripes at intervals of 800~~ **The optical elements 32 used for the first beam converter 30 generally are provided in a one-to-one correspondence with the active layer stripes 12 of the laser diode stack array 10 used for a laser device incorporating the first beam converter. Therefore, when for example using a laser diode stack array comprised of 20 arrays each comprised of 12 active layer stripes at intervals of 800** μm ~~and~~

~~stacked every 1.75 mm, the first beam converter becomes one comprised of arrays of 12 optical elements at intervals of 800~~ **m and stacked every 1.75 mm, the first beam converter becomes one comprised of arrays of 12 optical elements at intervals of 800** μm stacked every 1.75 mm.

[00202] ~~[0384]~~ However, as shown in the example shown in FIG. 9, when active layer stripes are arranged in a high density, it is deemed that the laser beams are emitted from a single continuous wave. By punctuating the laser received at the first beam converter at suitable intervals and rotating the laser beam by about 90° at each portion for use, it is possible to treat this as a laser diode linear array having ladder rung configuration emission parts having those intervals as widths and further as a laser diode stacked array comprised of these laser diode linear arrays stacked together.

~~[0385]~~ ~~For this purpose, it is~~ **For this purpose, it may be** sufficient to arrange a suitable number of optical elements in parallel two-dimensionally regardless of the number of active layer stripes.

[00203] ~~[0386]~~ To meet with the fact that the emission face of the laser diode stack array is a flat surface, it is convenient in terms of the structure of the laser device that the incidence faces and emission faces of the first beam converter 30 be arranged on single planes across the entirety of the first beam converter.

[00204] ~~[0387]~~ The above optical elements may be formed based on various principles as ~~shown~~**described** in U.S. Patent No. ~~5,513,201.~~

~~[0388]~~ **5,513,201, the entire disclosure of which is incoporated by reference.** First, there are ones based on twisting by three reflection actions. This is easy to understand if envisioning

three right angle prisms. That is, three right angle prisms are combined as shown in FIG. 52. If the first right angle prism receives a horizontally oriented flat laser beam, the beam is converted to a vertically oriented flat laser beam twisted 90° by the three total reflection actions in the first, second, and third prisms and is emitted from the third right angle prism. The functions performed by the three right angle prisms can be achieved by a single prism element as shown in FIG. 53. **If arranging such prism elements in a one-dimensional array to obtain a prism array such as in FIG. 54, an array of laser beams aligned linearly in a broken line configuration is received and is emitted converted to an array of laser beams aligned in parallel in a ladder rung configuration.**

~~[0389] If arranging such prism elements in a one dimensional array to obtain a prism array such as in FIG. 54, an array of laser beams aligned linearly in a broken line configuration is received and is emitted converted to an array of laser beams aligned in parallel in a ladder rung configuration.~~

~~[0390] Such a prism array can be formed monolithically from a single glass plate as shown in FIG. 55.~~

~~[0391] If vertically stacking such prism arrays to obtain a two dimensional array of prism elements as shown in FIG. 56, an array of laser beams comprised of broken lines arranged in parallel is received and is emitted converted to an array of laser beams comprised of ladder rungs aligned in parallel.~~

[00205] ~~[0392]~~ **Such a prism array can be formed monolithically from a single glass plate as shown in FIG. 55. If vertically stacking such prism arrays to obtain a two-dimensional array of prism elements as shown in FIG. 56, an array of laser beams comprised of broken**

lines arranged in parallel is received and is emitted converted to an array of laser beams comprised of ladder rungs aligned in parallel. The three reflection actions do not necessarily have to be at right angles as in a right angle prism. In the final analysis, it is sufficient that an array of laser beams comprised of broken lines arranged in parallel be received and converted to an array of laser beams comprised of ladder rungs aligned in parallel. **Further, the optical elements using reflection surfaces may also be not prisms, but suitably arranged reflection mirrors. When using reflection mirrors to form the beam converter, it is sufficient to form a mirror array so that the total reflecting faces of the prism array are used as the reflecting face. As the material, a metal, metal plated glass, reflective coated glass, plastic, silicon, etc. may be used.**

~~[0393] Further, the optical elements using reflection surfaces may also be not prisms, but suitably arranged reflection mirrors.~~

~~[0394] When using reflection mirrors to form the beam converter, it is sufficient to form a mirror array so that the total reflecting faces of the prism array are used as the reflecting face. As the material, a metal, metal plated glass, reflective coated glass, plastic, silicon, etc. may be used.~~

~~[0395] Fine optical elements can be produced by precision dies or produced by applying for example semiconductor production processes or LIGA processes. When using silicon crystals, processing also becomes easy is using the cleavage faces as reflecting mirror surfaces.~~

[00206] ~~[0396]~~ **Fine optical elements can be produced by precision dies or produced by applying for example semiconductor production processes or LIGA processes. When using**

silicon crystals, processing also becomes easy is using the cleavage faces as reflecting mirror surfaces. If using a one-dimensional mirror array, an array of laser beams aligned linearly in a broken line configuration is received and is emitted converted to an array of laser beams arranged in parallel in a ladder rung configuration. If vertically stacking such mirror arrays to obtain a two-dimensional array of mirror elements as shown in FIG. 57, an array of laser beams comprised of broken lines aligned in parallel is received and is emitted converted to an array of laser beams comprised of ladder rungs aligned in parallel.

~~[0397] FIG. 58 is a view of a first beam converter comprised of cylindrical lenses aligned in parallel. The first beam converter is comprised of two parallel arrangements of cylindrical lenses inclined 45° in axes facing each other across a space having a suitable distance.~~

~~[0398] The flat beams striking the incidence faces horizontally receive refractive forces differing depending on the incidence positions from the 45° inclined cylindrical lenses whereby they are rotated in flat axes and further are rotated in flat axes by a total of 90° by 45° inclined cylindrical lens and emitted from the emission faces.~~

[00207] ~~[0399]~~ FIG. 58 is a view of a first beam converter comprised of cylindrical lenses aligned in parallel. The first beam converter is comprised of two parallel arrangements of cylindrical lenses inclined 45° in axes facing each other across a space having a suitable distance. The flat beams striking the incidence faces horizontally receive refractive forces differing depending on the incidence positions from the 45° inclined cylindrical lenses whereby they are rotated in flat axes and further are rotated in flat axes by a total of 90° by 45° inclined cylindrical lens and emitted from the emission faces. By using the first beam converter, the stripe beams from the laser diode stack array are substantially changed to an array

of ladder rungs arranged in parallel. When the array of 45° inclined cylindrical lenses does not match the array of stripes of the adjoining LD linear array layers, the cylindrical lens array may be cut divided into different regions to correspond to the LD linear array layers and shifted to match with the stripes.

~~[0400] FIG. 59 shows a first beam converter comprised of a plurality of joined optical glass optical elements with incidence faces and emission faces having cylindrical surfaces, having parallel side faces, and having dense insides. These optical elements are also types of cylindrical lenses.~~

~~[0401] The optical elements are inclined 45° with respect to the horizontal plane. The flat beams striking the incidence faces horizontally receive different refractive forces arising at the cylindrical surfaces of the 45° inclined incidence faces whereby they are rotated in flat axes and further are rotated about 90° in flat axes at the 45° inclined cylindrical surfaces of the emission faces and emitted from the emission faces.~~

~~[0402] By using the first beam converter, the stripe beams from the laser diode stack array are substantially changed to an array of ladder rungs arranged in parallel.~~

[00208] ~~[0403]~~ **FIG. 59 shows a first beam converter comprised of a plurality of joined optical glass optical elements with incidence faces and emission faces having cylindrical surfaces, having parallel side faces, and having dense insides. These optical elements are also types of cylindrical lenses. The optical elements are inclined 45° with respect to the horizontal plane. The flat beams striking the incidence faces horizontally receive different refractive forces arising at the cylindrical surfaces of the 45° inclined incidence faces whereby they are rotated in flat axes and further are rotated about 90° in flat axes at the**

45° inclined cylindrical surfaces of the emission faces and emitted from the emission faces. By using the first beam converter, the stripe beams from the laser diode stack array are substantially changed to an array of ladder rungs arranged in parallel. When aligned with the intervals between stripe beams, there is no need for the side faces to be parallel faces. It is also possible to use cylindrical lenses with circular cross-sections. When the array of 45° inclined cylindrical lenses does not match the array of stripes of the adjoining LD linear array layers, in the same way as the above, the cylindrical lens array may be cut divided into different regions to correspond to the LD linear array layers and shifted to match with the stripes.

[00209] ~~[0404]~~ FIG. 60 shows a first beam converter fabricated from a block of optical glass. This beam converter is comprised of an optical glass prism with a rectangular cross-section formed on its incidence face and emission face with a plurality of cylindrical surfaces inclined 45° in the same direction and has the same functions as the beam converter of FIG. 59. **When the array of 45° inclined cylindrical surfaces does not match the array of stripes of the adjoining linear array LD layers, in the same way as the above, the cylindrical surface area may be cut divided into different regions to correspond to the LD linear array layers and shifted to match with the stripes.**

~~[0405] When the array of 45° inclined cylindrical surfaces does not match the array of stripes of the adjoining linear array LD layers, in the same way as the above, the cylindrical surface area may be cut divided into different regions to correspond to the LD linear array layers and shifted to match with the stripes.~~

[00210] ~~[0406]~~ FIG. 61 shows a first beam converter comprised of a plurality of dub prisms. The optical elements are inclined 45° with respect to the horizontal plane. The flat beams entering the incidence faces horizontally become flat beams emitted vertically at the emission faces since the reflection positions at the bottom surface differ depending on the incidence positions. **Therefore, the beams are emitted with flat axes rotated about 90°. By using the first beam converter, the stripe beams from the laser diode stack array change to an arrangement of ladder rungs aligned in parallel. When joining adjoining prisms, if necessary, it is possible to give the bottom surface of the dub prism a reflective coating. The beam converter may also be one using optical elements utilizing diffraction.**

~~[0407] Therefore, the beams are emitted with flat axes rotated about 90°. By using the first beam converter, the stripe beams from the laser diode stack array change to an arrangement of ladder rungs aligned in parallel. When joining adjoining prisms, if necessary, it is possible to give the bottom surface of the dub prism a reflective coating.~~

~~[0408] The beam converter may also be one using optical elements utilizing diffraction. FIG. 62 is a view of an optical element utilizing binary optical elements. This optical element is comprised of a transparent plate provided with a plurality of grooves arranged with center axes inclined 45° and changing in depth in a direction perpendicular to the center axes symmetrically with respect to the center axes.~~

[00211] ~~[0409]~~ **FIG. 62 is a view of an optical element utilizing binary optical elements. This optical element is comprised of a transparent plate provided with a plurality of grooves arranged with center axes inclined 45° and changing in depth in a direction**

perpendicular to the center axes symmetrically with respect to the center axes. The grooves change in depth so as to increase the diffraction angle the further from the centers to the outsides using diffraction. The stepped surface at the emission face is cut to be face symmetric with the stepped surface at the incidence face. The flat beams striking the incidence face horizontally receive refractive forces differing according to the incidence positions at the stepped surface with center axes inclined 45°, whereby the flat axes rotate. Further, from the emission face to the stepped surface with center axes inclined 45°, the flat axes rotate a total of 90° for emission of the beams from the emission face. **Such a binary optical element is comprised of optical glass or plastic. In addition to production by a semiconductor production process, it may also be produced using dies.**

~~[0410] Such a binary optical element is comprised of optical glass or plastic. In addition to production by a semiconductor production process, it may also be produced using dies.~~

~~[0411] FIG. 63 shows a first beam converter comprised of a plurality of joined one-dimensional profile refractive index lenses comprised of optical glass members becoming highest in refractive index at the center face and becoming lower in refractive index the closer to the side faces.~~

[00212] ~~[0412]~~ **FIG. 63 shows a first beam converter comprised of a plurality of joined one-dimensional profile refractive index lenses comprised of optical glass members becoming highest in refractive index at the center face and becoming lower in refractive index the closer to the side faces.** The one-dimensional profile refractive index lens is inclined 45° with respect to the horizontal plane. The flat beams striking the incidence face horizontally

receive refractive forces directed to the center face inclined 45°, whereby they are rotated about 90° in flat axes and emitted from the emission face.

[00213] ~~[0413]~~ FIG. 64 shows a first beam converter comprised of an optical glass plate formed on its two surfaces with a plurality of pairs of substantially semicylindrical profile refractive index elements arranged facing each other in the same directions. The center axes of the semicylinders are inclined 45° with respect to the horizontal plane. The refractive index is highest at the center of the semicircles, while the refractive index becomes lower the further to the outsides. **The two surfaces of the optical glass plate form the incidence face and the emission face. Flat beams striking the incidence face horizontally receive refractive forces differing according to the incidence positions due to profile refractive index lens elements inclined 45° and are emitted from the emission face rotated in flat axes about 90°.**

~~[0414] The two surfaces of the optical glass plate form the incidence face and the emission face. Flat beams striking the incidence face horizontally receive refractive forces differing according to the incidence positions due to profile refractive index lens elements inclined 45° and are emitted from the emission face rotated in flat axes about 90°.~~

~~[0415] FIG. 65 is a perspective view of a beam compressor using an anamorphic prism as an embodiment other than the reflection mirror type beam compressors or transmission lens type beam compressors shown up to here, while FIG. 66 is a plan view of the same.~~

~~[0416] If the anamorphic prism is struck by parallel beams having certain widths, they are converted to beams shortened in width due to the refractive effect and emitted from the anamorphic prism.~~

~~[0417] As shown in the perspective view of FIG. 67 and its plan view constituted by FIG. 68, if providing one more anamorphic prism to make an anamorphic prism pair, the two refraction effects further cause not only the width to be reduced, but also the emission optical axis to only move in parallel with the incidence optical axis and not change in direction.~~

[00214] ~~[0418]~~ FIG. 65 is a perspective view of a beam compressor using an anamorphic prism as an exemplary embodiment other than the reflection mirror type beam compressors or transmission lens type beam compressors shown up to here, while FIG. 66 is a plan view of the same. If the anamorphic prism is struck by parallel beams having certain widths, they are converted to beams shortened in width due to the refractive effect and emitted from the anamorphic prism. As shown in the perspective view of FIG. 67 and its plan view constituted by FIG. 68, if providing one more anamorphic prism to make an anamorphic prism pair, the two refraction effects further cause not only the width to be reduced, but also the emission optical axis to only move in parallel with the incidence optical axis and not change in direction. The group of laser beams comprised of a plurality of rows of laser beams, emitted from the first beam converter and arranged in parallel in a ladder rung configuration, further arranged in parallel to form a two-dimensional array is compressed by the anamorphic prism and converted to rows of laser beams where the individual rows of laser beams are compressed and the ladder rung intervals are shortened and as a result are converted to an arrangement wherein these compressed rows of laser beams are aligned in a single row. Further, if preparing another anamorphic prism pair and using a total of four anamorphic prisms, it is possible to position the emission optical axis in front of the incidence optical

axis. Of course, if a change in the orientation of the optical axis is not minded, it is also possible to use just one anamorphic prism.

~~[0419] Further, if preparing another anamorphic prism pair and using a total of four anamorphic prisms, it is possible to position the emission optical axis in front of the incidence optical axis. Of course, if a change in the orientation of the optical axis is not minded, it is also possible to use just one anamorphic prism.~~

~~[0420] The second beam converter 50, as shown in FIG. 51, is formed by linking a number of optical elements in a one dimensional array corresponding to the number of stack layers of the laser diode stack array. The optical elements 52 used for the second beam converter 50 are provided in a one to one correspondence with the compressed rows of laser beams emitted from the beam compressor 40.~~

~~[0421] When not using the first beam converter, but using the first beam compressor to first compress the fast axis components, the second beam converter divides and rotates the slow axis components. This is similar to the case of the quasi CW LDs being divided and rotated by the first beam converter.~~

[00215] ~~[0422]~~ **The second beam converter 50, as shown in FIG. 51, canbe formed by linking a number of optical elements in a one-dimensional array corresponding to the number of stack layers of the laser diode stack array. The optical elements 52 used for the second beam converter 50 are provided in a one-to-one correspondence with the compressed rows of laser beams emitted from the beam compressor 40. When not using the first beam converter, but using the first beam compressor to first compress the fast axis components, the second beam converter divides and rotates the slow axis components. This**

is similar to the case of the quasi-CW LDs being divided and rotated by the first beam converter. The optical elements 52 twist the incident laser beams 90° by the same principle as the optical elements 32 used for the first beam converter 30. Therefore, when the group of laser beams comprised of the compressed rows of parallel laser beams further aligned linearly is emitted from the beam compressor and enters the second beam converter, the compressed rows of parallel laser beams are twisted 90° and as a result become an arrangement wherein all of the laser beam elements are aligned in parallel in a single row. **The above optical elements can be formed based on the various principles used for the first beam converter.**

~~[0423] The above optical elements can be formed based on the various principles used for the first beam converter.~~

[00216] ~~[0424]~~ First, there are ones based on twisting by three reflection actions. As shown in FIG. 69, if arranging in a one-dimensional array prism elements which receive vertically oriented flat laser beams arranged in parallel horizontally and emit horizontally oriented flat laser beams twisted 90° by three reflection actions and arranged in parallel vertically, the group of laser beams comprised of the compressed rows of parallel laser beams further aligned linearly is received and is emitted converted to an arrangement where all laser beam elements are aligned in parallel in a single row. **Such a one-dimensional array can be formed monolithically from a single glass substrate as shown in FIG. 70.**

~~[0425] Such a one-dimensional array can be formed monolithically from a single glass substrate as shown in FIG. 70.~~

~~[0426] The three reflection actions do not necessarily have to be at right angles as in a right angle prism. In the final analysis, it is sufficient that the group of laser beams comprised of the compressed rows of parallel laser beams and aligned linearly be received and converted to an arrangement where all laser beam elements are aligned in parallel in a single row in the same way as the first beam converter.~~

~~[0427] Further, the optical elements using reflecting faces may also be not prisms, but suitably arranged reflection mirrors.~~

[00217] ~~[0428]~~ **The three reflection actions do not necessarily have to be at right angles as in a right angle prism. In the final analysis, it is sufficient that the group of laser beams comprised of the compressed rows of parallel laser beams and aligned linearly be received and converted to an arrangement where all laser beam elements are aligned in parallel in a single row in the same way as the first beam converter. Further, the optical elements using reflecting faces may also be not prisms, but suitably arranged reflection mirrors.** As shown in FIG. 71, by arranging in a one-dimensional array the mirror elements from which horizontally oriented flat laser beams twisted 90° by three reflection actions are emitted aligned vertically, a group of laser beams comprised of compressed rows of parallel laser beams further aligned linearly is received and is emitted converted to an arrangement where all laser beam elements are aligned in parallel in a single row.

[00218] ~~[0429]~~ FIG. 72 is a view of a second beam converter comprised of cylindrical lenses arranged in parallel. This beam converter is comprised of parallel arrangements of cylindrical lenses, inclined in axes by 45°, arranged facing each other across a space having a suitable distance.

[00219] ~~[0430]~~ The compressed row of parallel beams striking the incidence faces horizontally receive refractive forces differing according to the incident positions at the 45° inclined cylindrical lenses, whereby a row of beams is rotated in cross-section. The row of beams is rotated a total of about 90° in cross-section by the cylindrical lenses inclined 45° from the emission faces and emitted from the emission faces. **By using the second beam converter, the compressed row of parallel laser beams from the beam compressor and further the linearly arranged group of laser beams is substantially converted to an arrangement where all laser beams are aligned in parallel in one row in a ladder rung configuration. At such time, there is no need for the distance between all ladder rungs to be identical.**

~~[0431] By using the second beam converter, the compressed row of parallel laser beams from the beam compressor and further the linearly arranged group of laser beams is substantially converted to an arrangement where all laser beams are aligned in parallel in one row in a ladder rung configuration. At this time, there is no need for the distance between all ladder rungs to be identical.~~

~~[0432] FIG. 73 shows a beam converter comprised of a plurality of joined optical glass optical elements with incidence faces and emission faces having cylindrical surfaces, with parallel side faces parallel, and with dense insides. The optical elements are inclined 45° with respect to the horizontal plane.~~

~~[0433] The compressed row of laser beams striking the incidence faces horizontally receives different refractive forces occurring at the cylindrical surfaces of the 45° inclined incidence faces, whereby a row of beams is rotated in cross-section. The row of beams is rotated about 90° in~~

~~cross-section at the 45° inclined cylindrical surfaces of the emission faces and emitted from the emission faces.~~

[00220] ~~[0434]~~ ~~FIG. 73 shows a beam converter comprised of a plurality of joined optical glass optical elements with incidence faces and emission faces having cylindrical surfaces, with parallel side faces parallel, and with dense insides. The optical elements are inclined 45° with respect to the horizontal plane. The compressed row of laser beams striking the incidence faces horizontally receives different refractive forces occurring at the cylindrical surfaces of the 45° inclined incidence faces, whereby a row of beams is rotated in cross-section. The row of beams is rotated about 90° in cross-section at the 45° inclined cylindrical surfaces of the emission faces and emitted from the emission faces.~~ By using the second beam converter, the compressed row of parallel laser beams from the beam compressor and further the linearly arranged group of laser beams are substantially converted to an array in which all laser beams are aligned in parallel in a single row in a ladder rung configuration. At this time, there is no need for all of the distances between ladder rungs to be the same. When aligning the distances between the compressed row of parallel laser beams and the adjoining rows of beams, the side faces do not have to be parallel faces. It is also possible to utilize a cylindrical lens with a circular cross-section.

[00221] ~~[0435]~~ FIG. 74 shows a second beam converter fabricated from a block of optical glass. This beam converter is comprised of an optical glass prism with a rectangular cross-section and formed with a plurality of cylindrical surfaces inclined 45° in the same direction at the incidence face and emission face and has the same function as the second beam converter of FIG. 13.

[00222] ~~[0436]~~ FIG. 75 shows a second beam converter utilizing dub prisms. A compressed row of parallel laser beams striking an incidence face horizontally is refracted at the incidence face of a 45° inclined dub prism. The differences in incidence positions gives different reflection positions at the bottom surface, so at the emission face, the row of beams is refracted and emitted from the emission face rotated substantially 90° in cross-section. **When joining adjoining dub prisms, if necessary, the bottom surfaces of the dub prisms may be given a reflective coating in advance.**

~~[0437] When joining adjoining dub prisms, if necessary, the bottom surfaces of the dub prisms may be given a reflective coating in advance.~~

~~[0438] FIG. 76 shows a second beam converter utilizing binary optical elements. This beam converter is formed with a plurality of stepped surfaces with center axes inclined 45° in the same direction at the incidence faces and emission faces.~~

[00223] ~~[0439]~~ **FIG. 76 shows a second beam converter utilizing binary optical elements. This beam converter is formed with a plurality of stepped surfaces with center axes inclined 45° in the same direction at the incidence faces and emission faces.** The compressed row of parallel laser beams striking the incidence face horizontally receive different diffractive forces occurring at the stepped surface of the 45° inclined incidence face, whereby the row of beams is rotated. The row of beams is rotated 90° in cross-section at the 45° inclined stepped surface of the emission face and emitted from the emission face.

[00224] ~~[0440]~~ FIG. 77 shows a second beam converter utilizing one-dimensional profile refractive index lenses. This beam converter comprises a plurality of one-dimensional profile

refractive index lenses, comprised of optical glass members with the highest refractive indexes at the center faces and with refractive indexes becoming lower the closer to the side faces, joined inclined by 45°. **A row of parallel laser beams horizontally striking an incidence face receives different refractive forces depending on the incident positions in a 45° inclined one-dimensional profile refractive index lens, whereby the row of beams is rotated. The row of beams is emitted from the emission face rotated 90° in cross-section.**

~~[0441] A row of parallel laser beams horizontally striking an incidence face receives different refractive forces depending on the incident positions in a 45° inclined one-dimensional profile refractive index lens, whereby the row of beams is rotated. The row of beams is emitted from the emission face rotated 90° in cross section.~~

~~[0442] FIG. 78 shows a second beam converter utilizing facingly arranged profile refractive index lens elements. This beam converter comprises a plurality of substantially semicylindrical profile refractive index lens element forming pairs in the same direction and arranged facing each other at the two faces of the optical glass plate.~~

[00225] ~~[0443]~~ **FIG. 78 shows a second beam converter utilizing facingly arranged profile refractive index lens elements. This beam converter comprises a plurality of substantially semicylindrical profile refractive index lens element forming pairs in the same direction and arranged facing each other at the two faces of the optical glass plate.** The center axes of the semicylinders are inclined 45° with respect to a horizontal plane. The center of the semicircle is highest in refractive index, while the refractive index becomes lower the further to the outsides. The compressed row of parallel laser beams striking the incidence face horizontally receives different refractive forces depending on the incidence positions from the 45° inclined

one-dimensional profile refractive index lens elements, whereby the row of beams is rotated. The row of beams is emitted from the emission face rotated 90° in cross-section.

[00226] ~~[0444] As explained above, the present invention can use a beam converter comprised of a cylindrical lens array, but when laser beams having divergence angles enter this converter, as shown in FIG. 79, components projecting out to the adjoining elements at the beam exit side (in the figure, the escape components) occur and ghosts sometimes are produced. As a result, the thruput of the laser beams falls.~~

~~[0445]~~ **As described above, the exemplary embodiments of the present invention can use a beam converter comprised of a cylindrical lens array, but when laser beams having divergence angles enter this converter, as shown in FIG. 79, components projecting out to the adjoining elements at the beam exit side (in the figure, the escape components) occur and ghosts sometimes are produced. As a result, the thruput of the laser beams falls.** To eliminate the ghosts arising due to the divergence angles of the incident beams, it is necessary to give the converter the function of adjusting the divergence angles. Therefore, the inventors, as shown in FIG. 80, divides into two the beam converter comprised of the cylindrical lens array and makes the radii of curvature of the cylindrical lenses at the beam emission side smaller than the radii of curvature of the cylindrical lenses of the beam incidence side. **Therefore, it is possible to reduce the beam size at the beam emission side, eliminate the components where the laser beams protrude from the adjoining elements at the emission side (escape components), and suppress the occurrence of ghosts.**

~~[0446] Due to this, it is possible to reduce the beam size at the beam emission side, eliminate the components where the laser beams protrude from the adjoining elements at the emission side (escape components), and suppress the occurrence of ghosts.~~

~~[0447] FIG. 80 shows the beam incidence side converter and the beam exit side converter set apart and made variable in distance, but the two converters may also be joined to form an integral structure.~~

~~[0448] Note that FIG. 80 shows the case where the thickness r of the cylindrical lens is 0.354 mm, the radius of curvature r1 of the incidence side cylindrical lens is 0.375 mm, and the radius of curvature 42 of the exit side cylindrical lens is 0.3 mm.~~

~~[0449] It should be noted that, if r2/r1<1, the laser beams will not be fully rotated 90°, but this can be solved by arranging the cylindrical lenses at a slant.~~

[00227] ~~[0450] At the present~~**FIG. 80 shows the beam incidence side converter and the beam exit side converter set apart and made variable in distance, but the two converters may also be joined to form an integral structure. This figure shows the case where the thickness r of the cylindrical lens is 0.354 mm, the radius of curvature r1 of the incidence side cylindrical lens is 0.375 mm, and the radius of curvature 42 of the exit side cylindrical lens is 0.3 mm. If r2/r1<1, the laser beams will not be fully rotated 90°, but this can be solved by arranging the cylindrical lenses at a slant. At that** time, the output of commercially available laser diode stack arrays is about 50W per stack. Further, the number of stack layers ends up being limited to about 20 or so due to the mounting precision, so the output of one array

is about 1 kW at the maximum. However, if considering application to metal processing, a larger output ~~is necessary.~~

~~[0451] Therefore, in the present invention, at least two laser diode stack arrays may be coupled to increase the output.~~

~~[0452]~~ ~~That is, in~~**may be needed. Therefore, according to an exemplary embodiment of the present invention, at least two laser diode stack arrays may be coupled to increase the output. That is, according to an exemplary embodiment of** the present invention, at least two groups of laser beams emitted from at least two laser diode stack arrays and emitted from first condensers arranged in front of the arrays are coupled by an optical device arranged in front of the first condensers.

[00228] ~~[0453]~~ FIG. 81 shows the case of coupling using a polarization element as the optical device. The laser beam emitted from one laser diode stack array (LD2) is passed through a λ/2 plate and then coupled with a laser beam emitted from another laser diode stack array (LD1) through the polarization element (polarization prism). **FIG. 82 shows the state of coupling using a mirror formed with through windows at the same pitch as the stack pitch of the laser diode stack array. Further, FIG. 83 shows the state of coupling using small mirrors arranged at the same pitch as the stack pitch of the laser diode stack array. Further, FIG. 84 shows the state of coupling using right angle prisms arranged at the same pitch as the stack pitch of the laser diode stack array.**

~~[0454] FIG. 82 shows the state of coupling using a mirror formed with through windows at the same pitch as the stack pitch of the laser diode stack array.~~

~~[0455] Further, FIG. 83 shows the state of coupling using small mirrors arranged at the same pitch as the stack pitch of the laser diode stack array.~~

~~[0456] Further, FIG. 84 shows the state of coupling using right angle prisms arranged at the same pitch as the stack pitch of the laser diode stack array.~~

~~[0457] Further, in the present invention, as shown in FIG. 85, at least two laser diode stack arrays are provided, and an optical device for wavelength coupling the at least two groups of laser beams entering the third condenser is provided in back of the third condenser so as to couple the groups of laser beams.~~

~~[0458] In this case, it is preferable to use a dichroic mirror as the optical device.~~

[00229] ~~[0459] Further, in~~**Further, according to an exemplary embodiment of the present invention, as shown in FIG. 85, at least two laser diode stack arrays are provided, and an optical device for wavelength coupling the at least two groups of laser beams entering the third condenser is provided in back of the third condenser so as to couple the groups of laser beams. In this case, it may be preferable to use a dichroic mirror as the optical device. Further, according to an exemplary embodiment of** the present invention, a plurality of laser diode stack arrays provided with first condensers in front of them are provided, an optical device for coupling at least two groups of laser beams emitted from the condensers is provided in front of the first condensers, and an optical device for wavelength coupling at least two groups of laser beams striking the condensers is provided in back of the third condenser to couple the plurality of groups of laser beams. **In this manner, it is possible to couple a plurality of laser beams to obtain a large output laser beam.**

~~[0460] In this way, it is possible to couple a plurality of laser beams to obtain a large output laser beam.~~

[00230] ~~[0461]~~ FIG. 43 is a schematic plan view explaining a semiconductor laser pumped solid-state laser device **according to an exemplary embodiment** of the present invention, while FIG. 44 is an elevation view of the same. The semiconductor laser pumped solid-state laser device uses the semiconductor laser device of the present invention as a pumping light source of the solid-state laser 95. **A conventional semiconductor laser device utilizing a laser diode stack array is limited in the horizontal length region even if concentrating the energy. The substantive energy density does not become large. Further, if trying to effectively utilize this energy, only side face pumping of the solid-state laser is possible.**

~~[0462] A conventional semiconductor laser device utilizing a laser diode stack array is limited in the horizontal length region even if concentrating the energy. The substantive energy density does not become large. Further, if trying to effectively utilize this energy, only side face pumping of the solid-state laser is possible.~~

[00231] ~~[0463]~~ The semiconductor laser pumped solid-state laser device **according to an exemplary embodiment** of the present invention concentrates broken line configuration emission stripes of the laser diode stack array 10 in a direction perpendicular to the stripes by a first cylindrical lens array having a short focal length f1, then converts them to a plurality of rows of ladder rung configuration laser beams using a first beam converter 30 and also changes the direction of the beams so as to give a group of beams emitted simultaneously from the same

object. **Further, the condensing lens 70 makes the energy converge at a small region on the light receiving face of the solid-state laser element 96.**

~~[0464] Further, the condensing lens 70 makes the energy converge at a small region on the light receiving face of the solid-state laser element 96.~~

[00232] ~~[0465]~~ The semiconductor laser device **according to an exemplary embodiment** of the present invention, as explained above, can concentrate energy to a predetermined narrow range. Therefore, the semiconductor laser pumped solid-state laser device of the present invention utilizing the semiconductor laser device of the present invention can effectively use the output of the laser diode stack array 10 and enables end face pumping of the solid-state laser 95. **As the solid-state laser element, a YAG, YLF, yttria, or other ordinary solid-state laser element and also a solid-state laser element including a Q-switch or wavelength conversion element may also be utilized.**

~~[0466] As the solid-state laser element, a YAG, YLF, yttria, or other ordinary solid-state laser element and also a solid-state laser element including a Q-switch or wavelength conversion element may also be utilized.~~

[00233] ~~[0467]~~ Further, the pumping light source may be introduced to the solid-state laser element by the Brewster's angle. The solid-state laser element may also be a short absorption length laser crystal (YVO_4). The semiconductor laser pumped solid-state laser device of the present invention can give a 100W YAG laser output using a 300W semiconductor laser element.

[00234] ~~[0468]~~ FIG. 45 is a plan view of a laser device according to the present invention using an optical fiber 90, while FIG. 46 is an elevation view. The light receiving face of the optical

fiber 90 is arranged at the position of the laser spot formed by the above laser device to receive the laser energy emitted from the laser 10 and transmit it to the other end face side of the optical fiber 90.

~~[0469] Due to the length and flexibility of the optical fiber 90, it is possible to obtain an easy-to-use laser device enabling work while bringing the emission part to the target location.~~

~~[0470] Note that a laser device configured using as a light source a laser diode stack array 10 having a 800W output and forming a laser spot smaller than the cross-section of the core at the incidence face of an optical fiber 90 having a core diameter of 400~~ **Due to the length and flexibility of the optical fiber 90, it is possible to obtain an easy-to-use laser device enabling work while bringing the emission part to the target location. A laser device configured using as a light source a laser diode stack array 10 having a 800W output and forming a laser spot smaller than the cross-section of the core at the incidence face of an optical fiber 90 having a core diameter of 400** μ~~m achieves an efficiency of 60%.~~**m achieves an efficiency of 60%.**

[00235] ~~[0471]~~ FIG. 47 is a schematic plan view explaining an optical fiber guided semiconductor laser pumped solid-state laser device of the present invention, while FIG. 48 is an elevation view of the same. The optical fiber guided semiconductor laser pumped solid-state laser device guides the output of the semiconductor laser device of the present invention by an optical fiber 90 to form a pumping light source of the solid-state laser 95.

[00236] ~~[0472]~~ The output part of the optical fiber is provided with an optical system 92 for collimating and reconverging the energy of the laser beam diffused from the end.

~~[0473]~~ In this way, there is a flexible optical fiber between the semiconductor laser device part and the solid-state laser device part, so there are the advantages that the degree of freedom of the device is remarkably increased and configuration becomes easy. **The optical fiber guided semiconductor laser pumped solid-state laser device according to an exemplary embodiment of the present invention can give an 80W YAG laser output using a 400W semiconductor laser element.**

~~[0474] The optical fiber guided semiconductor laser pumped solid-state laser device of the present invention can give an 80W YAG laser output using a 400W semiconductor laser element.~~

~~[0475] FIG. 49 is a schematic plan view explaining a semiconductor laser pumped fiber laser device of the present invention, while FIG. 50 is an elevation view of the same.~~

[00237] ~~[0476]~~ **FIG. 49 is a schematic plan view explaining a semiconductor laser pumped fiber laser device of the present invention, while FIG. 50 is an elevation view of the same.** The semiconductor laser pumped fiber laser device inputs the output of the semiconductor laser device of the present invention to the inner cladding of the double clad fiber 91 to excite the core. The diameter of the inner cladding is 600 μm × 240 μm. The core diameter is 40 μm. When the output of the laser diode stack array is 1 kW, a fiber laser output of 500W is obtained. This output beam is a completely single peak type.

~~CLAIMS~~

~~A semiconductor laser device provided with:~~

~~1.~~ ~~a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array;~~

~~2.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~3.~~ ~~a first beam converter (30) provided in front of said first condenser (20), receiving said group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in said first direction for every row;~~

~~4.~~ ~~a second condenser (80) provided in front of said first beam converter (30), bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row, and using each with center axes offset by exactly predetermined amounts to convert them to beams emitted from approximately the same object by generating an angular change of the optical axes;~~

~~5.~~ ~~a first beam compressor (40) receiving said group of laser beams output from said second condenser (80) and emitting it converted to a compressed substantially ladder rung~~

~~configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows; and~~

~~6.~~ ~~a third condenser (70) for condensing said group of laser beams output from said first beam compressor (40).~~

~~A semiconductor laser device provided with:~~

~~7.~~ ~~one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in said first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~8.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~9.~~ ~~a first beam converter (30) provided in front of said first condenser, dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical~~

~~element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~10. a second condenser (80) provided in front of said first beam converter, bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row, and using each with center axes offset by exactly predetermined amounts to convert them to beams emitted from approximately the same object by generating an angular change of the optical axes;~~

~~11. a first beam compressor (40) receiving said group of laser beams output from said second condenser (80) and emitting it converted to a substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows; and~~

~~12. a third condenser (70) for condensing said group of laser beams output from said first beam compressor (40).~~

~~A semiconductor laser device provided with:~~

~~13. a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array;~~

~~14. a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~15. a first beam converter (30) provided in front of said first condenser (20), receiving said group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in said first direction for every row;~~

~~16. a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~17. a first beam compressor (40) receiving said group of laser beams output from said second condenser (80) and emitting it converted to a compressed substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows;~~

~~18. an angle changer provided in front of one of said second condenser (80) and said first beam compressor (40), receiving said substantially ladder rung configuration group of laser beams extending in said first direction of the plurality of rows, and changing the center optical axes of the group of beams to said second direction for each row to obtain a group of beams emitted from substantially the same object; and~~

~~19. a third condenser (70) for condensing said group of laser beams changed in center optical axes.~~

~~A semiconductor laser device provided with:~~

~~20. one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam~~

~~elements arranged in a two dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in said first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~21.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~22.~~ ~~a first beam converter (30) provided in front of said first condenser (20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~23.~~ ~~a second condenser (80) provided in front of said first beam converter (30), bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~24.~~ ~~a first beam compressor (40) receiving said group of laser beams output from said second condenser (80) and emitting it converted to a substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows;~~

~~25. an angle changer provided in front of one of said second condenser (80) and said first beam compressor (40), receiving said substantially ladder rung configuration group of laser beams extending in said first direction of the plurality of rows, and changing the center optical axes of the group of beams to said second direction for each row to obtain a group of beams emitted from substantially the same object; and~~

~~26. a third condenser (70) for condensing said group of laser beams.~~

~~27. A semiconductor laser device as set forth in claim 3 or 4, wherein one of said second condenser (80) and said first beam converter (40) and said angle changer are formed integrally.~~

~~A semiconductor laser device provided with:~~

~~28. a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array;~~

~~29. a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~30. a first beam converter (30) provided in front of said first condenser (20), receiving said group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in said first direction for every row;~~

~~31. a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row; and~~

~~32. a third condenser (70) for receiving said group of laser beams output from the second condenser (80), forming images, and reduce the distance between rows.~~

~~A semiconductor laser device provided with:~~

~~33. one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in said first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~34. a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~35. a first beam converter (30) provided in front of said first condenser (20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each~~

~~optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~36.~~ ~~a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row; and~~

~~37.~~ ~~a third condenser (70) for receiving said group of laser beams, forming images, and reducing the distance between rows.~~

~~A semiconductor laser device provided with:~~

~~38.~~ ~~a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array;~~

~~39.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~40.~~ ~~a first beam converter (30) provided in front of said first condenser (20), receiving said group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in said first direction for every row;~~

~~41.~~ ~~a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~42. a fourth condenser (71) provided in front of said second condenser (80), receiving said substantially ladder rung configuration group of laser beams extending in said first direction of the plurality of rows, forming images, and reducing the distance between rows; and~~

~~43. a third condenser (70) for further reducing and reforming the image from the fourth condenser (71).~~

~~A semiconductor laser device provided with:~~

~~44. one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in said first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~45. a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~46. a first beam converter (30) provided in front of said first condenser (20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each~~

~~optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~47.~~ ~~a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~48.~~ ~~a fourth condenser (71) provided in front of said second condenser (80), receiving said substantially ladder rung configuration group of laser beams extending in said first direction of the plurality of rows, forming images, and reducing the distance between rows; and~~

~~49.~~ ~~a third condenser (70) for further reducing and reforming the image from the fourth condenser (71).~~

~~50.~~ ~~A semiconductor laser device as set forth in claim 8 or 9, further provided with an angle changer provided at the image forming plane of said fourth condenser or in its vicinity and changing the center optical axes of the group of beams to said second direction for each row to obtain a group of beams emitted from substantially the same object.~~

~~A semiconductor laser device provided with:~~

~~51.~~ ~~a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array;~~

~~52.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~53.~~ ~~a first beam converter (30) provided in front of said first condenser (20), receiving said group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in said first direction for every row;~~

~~54.~~ ~~a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~55.~~ ~~a first beam compressor (110, 111) receiving said group of laser beams output from said second condenser (80) and emitting it converted into a compressed substantially ladder rung configuration group of laser beams extending in said first direction of the plurality of rows;~~

~~56.~~ ~~a second beam compressor (112, 113) provided in front of said first beam compressor (110, 111) and emitting the laser beams output from said first beam compressor (110, 111) converted into a group of laser beams with shortened intervals of the rows and compressed in said second direction of the plurality of rows;~~

~~57.~~ ~~a fourth condenser (60) for receiving the beams output from said second beam compressor (113) and making the beam divergence angle in said first direction close to the beam divergence angle of said second direction; and~~

~~58.~~ ~~a third condenser (70) for condensing the group of laser beams output from said fourth condenser (60).~~

~~A semiconductor laser device provided with:~~

~~59.~~ ~~one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction~~

~~and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in said first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~60.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~61.~~ ~~a first beam converter (30) provided in front of said first condenser (20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction, rotating the axes of the cross sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~62.~~ ~~a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~63.~~ ~~a first beam compressor (110, 111) receiving said group of laser beams output from said second condenser (80) and emitting it converted into a compressed substantially ladder rung configuration group of laser beams extending in said first direction of the plurality of rows;~~

~~64. a second beam compressor (112, 113) provided in front of said first beam compressor (110, 111) and emitting the laser beams output from said first beam compressor (110, 111) converted into a group of laser beams with shortened intervals of the rows and compressed in said second direction of the plurality of rows;~~

~~65. a fourth condenser (60) for receiving the beams output from said second beam compressor (113) and making the beam divergence angle in said first direction close to the beam divergence angle of said second direction; and~~

~~66. a third condenser (70) for condensing the group of laser beams output from said fourth condenser (60).~~

~~A semiconductor laser device provided with:~~

~~67. a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array;~~

~~68. a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~69. a first beam converter (30) provided in front of said first condenser, receiving said group of laser beams collimated in the second direction, and emitting it converted to a substantially ladder rung configuration group of laser beams extending in said first direction for every row;~~

~~70.~~ ~~a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~71.~~ ~~a first beam compressor (150, 151) receiving said group of laser beams output from said second condenser (80) and emitting it converted into a compressed substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows;~~

~~72.~~ ~~a second beam compressor (152, 153) provided in front of said first beam compressor (150, 151) and emitting the laser beams converted into a compressed group of laser beams with shortened intervals of the rows and extending in said second direction of the plurality of rows;~~

~~73.~~ ~~an angle changer provided inside one of said first beam compressor (150, 151) and said second beam compressor (150, 151) and changing the optical axis angles; and~~

~~74.~~ ~~a third condenser (70) for condensing the group of laser beams.~~

~~A semiconductor laser device provided with:~~

~~75.~~ ~~one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in said first direction and arranged in a plurality of rows and emitting a group of~~

~~laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~76.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~77.~~ ~~a first beam converter (30) provided in front of said first condenser (20), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~78.~~ ~~a second condenser (80) provided in front of said first beam converter (30) and bending and collimating said group of laser beams output from said first beam converter (30) in a second direction substantially at right angles to said first direction for every row;~~

~~79.~~ ~~a first beam compressor (110, 111) receiving said group of laser beams output from said second condenser (80) and emitting it converted into a compressed substantially ladder rung configuration group of laser beams extending in said first direction of the plurality of rows;~~

~~80.~~ ~~a second beam compressor (112, 113) provided in front of said first beam compressor (110, 111) and emitting the laser beams output from said first beam compressor (110, 111) converted into a compressed group of laser beams with shortened intervals of the rows and extending in said second direction of the plurality of rows;~~

~~81.~~ ~~an angle changer provided inside one of said first beam compressor (110, 111) and said second beam compressor (112, 113) and changing the optical axis angles; and~~

~~82.~~ ~~a third condenser (70) for condensing the group of laser beams.~~

~~83.~~ ~~A semiconductor laser device as set forth in claim 13 or 14, wherein said beam compressors are comprised by a two-dimensional beam compressor (140, 141) combining the functions of the first beam compressor and second beam compressor.~~

~~84.~~ ~~A semiconductor laser device as set forth in claim 13 or 14, further provided with a second beam converter (50) provided between said first beam compressor and said second beam compressor, receiving said substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows, converting it to substantially ladder rung configuration laser beams extending in said second direction for each row, and as a result emitting it converted to a single row of substantially ladder rung configuration laser beams with all laser beams extending in said second direction.~~

~~A semiconductor laser device as set forth in claim 16, further provided with:~~

~~85.~~ ~~a second beam converter (50) provided between said first beam compressor and said second beam compressor, receiving said substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows, converting it to substantially ladder rung configuration laser beams extending in said second direction for each row, and as a result emitting it converted to a single row of substantially ladder rung configuration laser beams with all laser beams extending in said second direction and~~

~~86.~~ ~~an angle changer provided in front of said second beam converter (50) and changing the center optical axes of the group of beams to said second direction to obtain a group of beams emitted from substantially the same object.~~

~~87.~~ ~~A semiconductor laser device as set forth in claim 16 or 17, further provided with a fifth condenser (154) provided between said first beam compressor and said second beam converter, receiving said substantially ladder rung configuration group of laser beams with shortened ladder rung intervals and extending in said first direction of the plurality of rows and emitting it bending and collimating the laser beams of each row.~~

~~88.~~ ~~A semiconductor laser device as set forth in claim 18, wherein said fifth condenser (154) is a cylindrical lens.~~

~~89.~~ ~~A semiconductor laser device as set forth in any one of claims 1 to 19, further provided with a shifter provided between said first beam converter and said second condenser and shifting in parallel optical axes in said second direction for each row.~~

~~90.~~ ~~A semiconductor laser device as set forth in any one of claims 1 or 20, further provided with a shifter provided between said first condenser and said first beam converter and shifting in parallel optical axes in said second direction for each row.~~

~~91.~~ ~~A semiconductor laser device as set forth in any one of claims 1 to 21, wherein said second condenser is a one-dimensional array of cylindrical lenses.~~

~~A semiconductor laser device provided with:~~

~~92.~~ ~~a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and~~

~~arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two-dimensional array;~~

~~93.~~ ~~a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~94.~~ ~~a second beam compressor (112, 113) provided in front of said first condenser (20), receiving said group of laser beams collimated in said second direction, and emitting the laser beams converted into a group of laser beams with compressed distances between optical axes in said second direction;~~

~~95.~~ ~~a first beam converter (50) provided in front of said second beam compressor (112, 113), dividing the group of laser beams in each row, providing in each row in parallel optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction and compressed in distance between optical axes in said second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder-rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~96.~~ ~~a first beam compressor (110, 111) provided in front of said first beam converter (50) and emitting said laser beams converted into a group of laser beams compressed in said first direction;~~

~~97. a second condenser (60) provided in front of said first beam compressor (110, 111) and making the beam divergence angle of said first direction close to the divergence angle of said second direction; and~~

~~a third condenser (70) for condensing said group of laser beams.~~

~~98. A semiconductor laser device provided with:~~

~~99. one of a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly in said first direction and arranged in a plurality of rows and emitting a group of laser beams having laser beam elements arranged in a two dimensional array and a laser diode stack array provided with a plurality of emitters, extending long in a first direction of emission of laser beams, to be arranged linearly densely in said first direction and arranged in a plurality of rows and emitting a group of laser beams comprised of laser beams substantially continuing linearly arranged in a plurality of rows;~~

~~100. a first condenser (20) provided in front of said laser diode stack array and bending and collimating said group of laser beams for every row in a second direction substantially at right angles to said first direction;~~

~~101. a second beam compressor (112, 113) provided in front of said first condenser (20), receiving said group of laser beams collimated in said second direction, and emitting the laser beams converted into a group of laser beams with compressed distances between optical axes in said second direction;~~

~~102. a first beam converter (50) provided in front of said second beam compressor (112, 113), dividing the group of laser beams in each row, providing in each row in parallel~~

~~optical elements for bending the axes of the cross-sections of the laser beam units to substantially right angles using as units the divided pluralities of laser beams, receiving said group of laser beams collimated in the second direction and compressed in distance between optical axes in said second direction, rotating the axes of the cross-sections of the laser beam units for each optical element, and emitting the beams as a substantially ladder rung configuration group of laser beams extending in said first direction using said divided pluralities of laser beams as units;~~

~~103. a first beam compressor (110, 111) provided in front of said first beam converter (50) and emitting said laser beams converted into a group of laser beams compressed in said first direction;~~

~~104. a second condenser (60) provided in front of said first beam compressor (110, 111) and making the beam divergence angle of said first direction close to the divergence angle of said second direction; and~~

~~105. a third condenser (70) for condensing said group of laser beams.~~

~~106. A semiconductor laser device as set forth in claim 24, further provided with a fifth condenser (155) provided between said second beam compressor and said first beam converter, receiving a group of laser beams with distances between optical axes in said second direction compressed, and emitting the laser beams of each row bent and collimated in said second direction.~~

~~107. A semiconductor laser device as set forth in claim 25, wherein said fifth condenser (155) is a cylindrical lens.~~

~~108. A semiconductor laser device as set forth in claim 25 or 26, further provided with, in front of said second beam compressor (110, 111), an angle changer changing the center optical~~

~~axes of the group of beams to obtain a group of beams emitted from substantially the same object.~~

~~109. A semiconductor laser device as set forth in any one of claims 3 to 5, 10, 13 to 14, 17 to 22, and 27, wherein said angle changer is one of an inclined transparent plate and an array of wedge prisms.~~

~~110. A semiconductor laser device as set forth in any one of claims 3 to 5, 10, 13 to 14, 17 to 22, and 27 to 28, wherein said angle changer is an array of cylindrical lenses.~~

~~111. A semiconductor laser device as set forth in any one of claims 3 to 5, 10, 13 to 14, 17 to 22, and 27 to 29, wherein said angle changer is a segment type reflection mirror.~~

~~112. A semiconductor laser device as set forth in any one of claims 1 to 30, wherein said beam compressor is comprised of one of an anamorphic prism and anamorphic prism pair.~~

~~113. A semiconductor laser device as set forth in any one of claims 1 to 31, wherein said beam compressor is a telescope using one of one-dimensional and two-dimensional lenses.~~

~~114. A semiconductor laser device as set forth in any one of claims 1 to 32, wherein said beam compressor is a telescope using one of a one-dimensional and two-dimensional parabolic mirror.~~

~~115. A semiconductor laser device as set forth in any one of claims 1 to 33, wherein said first condenser is a one-dimensional array of cylindrical lenses.~~

~~116. A semiconductor laser device as set forth in any one of claims 1 to 34, further provided, in front of said first condenser, with an angle adjuster for finely adjusting the angle of optical axes for each row to said second direction.~~

~~117. A semiconductor laser device as set forth in claim 35, wherein said angle adjuster combines at least two wedge plates in reverse directions and can rotate at least one wedge plate.~~

~~118. A semiconductor laser device as set forth in any one of claims 1 to 36, using as a beam converter a beam converter comprising a plurality of optical elements each provided with:~~

~~119. a receiving part for receiving incident light beams having cross-sections perpendicular to the optical axes as first axes,~~

~~120. an optical system for rotating the first axis of said beam cross-sections to substantially right angles, and~~

~~121. an emission part for emitting emitted beams passing through said optical system,~~

~~122. said optical elements arranged on the optical axes of the laser beams and the receiving parts and emission parts of said optical elements arranged adjoining each other two-dimensionally on the same planes.~~

~~123. A semiconductor laser device as set forth in claim 37, wherein said optical element is a space defined by reflecting faces, said space providing a first reflecting face vertical and inclined about 45° with respect to incident beams, a second reflecting face parallel to the incident beams and inclined about 45° with respect to the horizontal plane, and a third reflecting face perpendicular to the vertical surface parallel to the incident beams, parallel to the line of intersection between said first reflecting face and second reflecting face, and inclined about 45° with respect to the horizontal plane.~~

~~124. A semiconductor laser device as set forth in claim 37, wherein said optical element is a prism comprised of a first total reflecting face, a second total reflecting face, a third total reflecting face, an incidence face, an emission face, and a joining face, in which prism said~~

~~first, second, and third total reflecting faces intersect each other with intersecting angles of 60°, said incidence face and emission face are parallel and perpendicularly intersect said second total reflecting face and are inclined about 45° with respect to said first and third total reflecting faces, and said joining face is parallel to said second total reflecting face, and wherein one of a one-dimensional array of prisms comprised of said prisms arranged adjoining each other with said third total reflecting faces, incidence faces, and emission faces on the same planes and with joining faces and second total reflecting faces of adjoining prisms joined together and a two-dimensional array comprised of one dimensional arrays of prisms further aligned in parallel is used as said beam converter.~~

~~125. A semiconductor laser device as set forth in claim 37, wherein one of an optical glass member having parallel first and second flat surfaces, a third flat surface intersecting said first flat surface by an angle of 135°, and a fourth surface comprised of a cyclically bent surface comprised of peaks and valleys having a bending angle of the line along which the peaks and valleys extend of 60°, formed continuously in a wave configuration in a direction intersecting said first flat surface by an angle of $\tan^{-1}(1/\sqrt{2})$, and having peak lines and valley lines parallel to said third flat surface, said first flat surface being used as an incidence face, said second flat surface being used as an emission face, said faces among the bent faces forming said fourth surface intersecting said first flat surface by an angle of 45° being used as a first reflecting face, the other faces being used as a second reflecting face, and said third flat surface being used as a third reflecting face, and a one-dimensional array comprised of said optical glass members further aligned linearly is used as a beam converter.~~

~~126. A semiconductor laser device as set forth in claim 37, wherein one of a mirror structure having a first flat surface intersecting a flat surface perpendicular to an incidence optical axis by an angle of 135°, a second surface comprised of a cyclically bent surface comprised of peaks and valleys having a bending angle of the line along which the peaks and valleys extend of 60°, formed continuously in a wave configuration in a direction intersecting a flat surface perpendicular to said incidence optical axis by an angle of~~ $\cancel{\tan^{-1}(1/\sqrt{2})}$~~, and having peak lines and valley lines parallel to said first flat surface, said first flat surface and said second surface being treated to form mirror surfaces, said faces among the bent faces forming said second surface intersecting said flat surface perpendicular to said incidence optical axis by an angle of 45° being used as a first reflecting face, the other faces being used as a second reflecting face, and said first flat surface being used as a third reflecting face, and a one dimensional array comprised of said mirror structures further aligned linearly is used as a beam converter.~~

~~127. A semiconductor laser device as set forth in claim 37, wherein said optical element is comprised of a pair of convex cylindrical lenses each with axes inclined about 45° arranged facing each other across a space of a predetermined distance.~~

~~128. A semiconductor laser device as set forth in claim 37, wherein said optical element is comprised of an array of a plurality of pairs of convex cylindrical lenses each with axes inclined about 45° arranged facing each other across a space of a predetermined distance.~~

~~129. A semiconductor laser device as set forth in claim 42 or 43, wherein in said pairs of cylindrical lenses, a radius of curvature of emission side lenses is smaller than a radius of curvature of incidence side lenses.~~

~~130. A semiconductor laser device as set forth in claim 37, wherein said optical element is a cylindrical lens having convex lens parts at the two ends of the side faces and wherein a plurality of optical elements are joined inclined by about 45° with respect to an incidence optical axis.~~

~~131. A semiconductor laser device as set forth in claim 37, wherein said beam converter is a one-dimensional array of a plurality of cylindrical lenses having convex lens parts at the two ends of the side faces joined inclined by about 45° with respect to an incidence optical axis.~~

~~132. A semiconductor laser device as set forth in claim 45 or 46, wherein in said convex lens parts, a radius of curvature of emission side lenses is smaller than a radius of curvature of incidence side lenses.~~

~~133. A semiconductor laser device as set forth in claim 37, wherein said beam converter is comprised of an optical glass prism having a rectangular cross-section formed with a plurality of cylindrical surfaces inclined about 45° in the same direction as its incidence face and emission face and emits incident beams entering its cylindrical surfaces rotated about 90° in cross-section.~~

~~134. A semiconductor laser device as set forth in claim 48, wherein, in said cylindrical surfaces, a radius of curvature of emission side surfaces is smaller than a radius of curvature of incidence side surfaces, with the angle of inclination adjusted to emit incident beams entering its cylindrical surfaces rotated about 90° in cross-section.~~

~~135. A semiconductor laser device as set forth in claim 37, wherein said optical element is a dub prism having a trapezoidal cross-section and a plurality of said optical elements is arranged inclined by about 45°.~~

~~136. A semiconductor laser device as set forth in claim 37, wherein said optical element is comprised of two optical elements changing in power in only a direction perpendicular to a center axis due to diffraction and arranged with center axes inclined about 45°.~~

~~137. A semiconductor laser device as set forth in claim 37, wherein said beam converter is comprised of, at both the incidence side and emission side, a pair of binary optic elements arranged facing each other across a space of a predetermined distance, the surfaces of the incidence side binary optic element and emission side binary optic element being formed with pluralities of axially symmetric stepped surfaces changing in depth so that the powers change symmetric to center axes inclined about 45° in directions perpendicular to the center axes, and emits incident beams entering the axially symmetric stepped surfaces rotated about 90° in cross-section.~~

~~138. A semiconductor laser device as set forth in claim 37, wherein said optical element is comprised of an optical element comprised of a structure with continuously changing refractive indexes and changing in power in only a direction perpendicular to the orientation of arrangement and is arranged inclined 45° with respect to a horizontal plane.~~

~~139. A semiconductor laser device as set forth in claim 37, wherein said beam converter is comprised of a plurality of one-dimensional profile refractive index lens elements comprised of optical glass members with refractive indexes highest at the center faces and~~

~~becoming lower the closer to the side faces and joined with said center faces inclined about 45° with respect to a horizontal plane.~~

~~140. A semiconductor laser device as set forth in claim 37, wherein said beam converter is comprised of an optical glass plate on both surfaces of which are formed pluralities of semicylindrical profile refractive index lens elements inclined about 45° with respect to those surfaces, arranged facing each other in the same direction, and having refractive indexes highest at the centers of the semicylinders and the refractive indexes becoming lower the further to the outsides.~~

~~141. A semiconductor laser device as set forth in any one of claims 1 to 55, provided with at least two laser diode stack arrays provided with said first condensers in front and provided with an optical device for coupling the at least two groups of laser beams emitted from said first condensers in front of said condensers.~~

~~142. A semiconductor laser device as set forth in any one of claims 1 to 55, provided with at least two laser diode stack arrays and provided with an optical device for wavelength coupling the at least two groups of laser beams entering said third condenser after said condenser.~~

~~143. A semiconductor laser device as set forth in any one of claims 1 to 55, provided with at least three laser diode stack arrays provided with said first condensers in front and provided with an optical device for coupling the at least two groups of laser beams emitted from said first condensers in front of said condensers and provided with an optical device for wavelength coupling at least two groups of laser beams entering said third condenser after said condenser.~~

~~144. A semiconductor laser device as set forth in claim 56 or 58, wherein said optical device is a polarization element.~~

~~145. A semiconductor laser device as set forth in claim 56 or 58, wherein said optical device is a mirror formed with through windows at the same pitch as the stack pitch of said laser diode stack array.~~

~~146. A semiconductor laser device as set forth in claim 56 or 58, wherein said optical device is comprised of mirrors arranged at the same pitch as the stack pitch of said laser diode stack array.~~

~~147. A semiconductor laser device as set forth in claim 56 or 58, wherein said optical device is comprised of right angle prisms arranged at the same pitch as the stack pitch of said laser diode stack array.~~

~~148. A semiconductor laser device as set forth in claim 57 or 58, wherein said optical device is a dichroic mirror.~~

~~149. A semiconductor laser device as set forth in any one of claims 1 to 63, further provided with an optical fiber having an end face at a focal plane of said third condenser.~~

~~150. A semiconductor laser device as set forth in claim 64, wherein said optical fiber is an optical fiber with a core doped with a rare earth element.~~

~~151. A semiconductor laser pumped solid-state laser device provided with a semiconductor laser device as set forth in any one of claims 1 to 65 and a solid-state laser element with a pumped light receiving face matched with a focal position of said third condenser.~~

~~152. A semiconductor laser pumped solid-state laser device provided with a semiconductor laser device as set forth in claim 64, an optical system for collimating the beams~~

~~emitted from the optical fiber as set forth in claim 64 so as to converge them to the focal point, and a solid state laser element having a pumped light receiving face and having said pumped light receiving face matched with the position of said focal point.~~

~~153. A semiconductor laser-pumped solid state laser device as set forth in claim 67, wherein said optical fiber is an optical fiber with a core doped with a rare earth element.~~

~~ABSTRACT OF THE DISCLOSURE~~

~~A semiconductor laser device comprised of a laser element stack array emitting a two-dimensional array shaped group of laser beams consisting of rows of laser beams arranged linearly in a broken line configuration further aligned in parallel and optical elements arranged in front of the array, receiving rows of laser beams bent and collimated in a direction substantially perpendicular to the orientation of the broken line, and emitting from emitters or groups of emitters laser beams rotated in orientation by right angles so as to convert the laser beams to a plurality of rows aligned in parallel in an approximate ladder rung configuration configuration and shortening the distance between center axes of the rows of laser beams to condense them by converting them to a group of laser beams emitted from a common object and thereby making all laser beams converge to a single image.~~

[00238]

Document comparison done by DeltaView on Tuesday, September 14, 2004 9:17:37 AM

Input:	
Document 1	PowerDocs://NY02/491473/1
Document 2	PowerDocs://NY02/491591/1
Rendering set	Bold Double Underline-Strikethrough

Legend:	
Insertion	
~~Deletion~~	
~~Moved from~~	
Moved to	
Style change	
Format change	
~~Moved deletion~~	
Inserted cell	
Deleted cell	
Moved cell	
Split/Merged cell	
Padding cell	

Redline Summary:		
No.	**Change**	**Text**
1	Insertion	
2	Insertion	SUBSTITUTE SPECIFICATION
3-4	Change	"NY02:491473.1 -1-" changed to "NY02:491591.1 -1-"
5	Insertion	CROSS-REFERENCE TO RELATED APPLICATION(S)
6-7	Insertion	[0001] This application...herein by reference.
8-9	Change	"BACKGROUND OF THE INVENTION" changed to "FIELD OF THE INVENTION"
10	Deletion	1. Field of the Invention
11	Change	"The present" changed to "[0001] The present"
12	Change	"beam converter used for a" changed to "beam converter capable of being used for a"
13	Change	"laser device using" changed to "laser device that is capable of using"

14-15	Change	"using that beam converter." changed to "using such beam converter."
16-17	Change	"laser condenser for condensing" changed to "laser condenser capable of condensing"
18-19	Change	"laser device for pumping a beam of a" changed to "laser device configured to pump a beam of a"
20	Deletion	2. Description of the Related Art
21	Insertion	BACKGROUND INFORMATION
22-23	Change	"arrays of semiconductor" changed to "[0002] At the present...arrays of semiconductor"
24-25	Change	"of about 50W are available." changed to "of about 50W have been available."
26	Change	"By stacking" changed to "[0003] By stacking"
27-28	Change	"fine spot, it should be possible to" changed to "fine spot, it is likely possible to"
29-30	Change	"possible to use it for a various" changed to "possible to use such laser beams for a various"
31	Change	"It" changed to "[0004] It"
32-33	Change	"It is possible to" changed to "It may be possible to"
34-35	Change	"semiconductor laser gives a light source" changed to "semiconductor laser provides a light source"
36	Change	"Each stripe" changed to "[0005] Each stripe"
37	Change	"For example," changed to "[0006] For example,"
38	Change	"laser diode (LD" changed to "laser diode ("LD"
39	Change	"LD) stack array" changed to "LD") stack array"
40	Change	"Therefore," changed to "[0007] Therefore,"
41	Change	"Therefore, to collimate" changed to "Therefore, in order to collimate"
42	Change	"In this way," changed to "[0008] In this way,"
43-44	Change	"To utilize a LD stack array" changed to "To utilize the LD stack array"
45	Change	"Further, if" changed to "[0009] Further, if"
46-47	Change	"Further, if attempting to use a semiconductor"

		changed to "Further, if an attempt is...to use a semiconductor"
48	Change	"solid-state laser," changed to "solid-state laser"
49	Change	"as" changed to "(as"
50-51	Change	"as explained above" changed to "as described above"
52	Change	"above, since the" changed to "above), since the"
53-54	Change	"about 1 cm, it was not" changed to "about 1 cm, it may not"
55	Change	"not possible to" changed to "not be possible to"
56	Change	"possible to focus a...of beams to a single" changed to "possible to focus beams to a single"
57-58	Change	"pumping system could not be used," changed to "pumping system may not be used,"
59	Change	"application was only possible" changed to "application was previously only possible"
60	Change	"Further, matching" changed to "[0010] Further, matching"
61-62	Change	"pumping space is important in" changed to "pumping space can be important in"
63	Change	"solid-state laser, as well. A double" changed to "solid-state laser. A double"
64-65	Change	"output, a special means was" changed to "output, a special may was"
66-67	Change	"was required for concentrating" changed to "was previously used for concentrating"
68	Change	"In view of the" changed to "[0011] In view of the"
69-70	Change	"above problems, an object of the present" changed to "above problems, one of the objects of the present"
71	Change	"stack array and able to" changed to "stack array, and able to"
72-73	Change	"object of the" changed to "[0012] Still anotherAnother object of the"
74-75	Change	"present invention" changed to "[0013] TheAn exemplary...of the present invention"
76-77	Change	"present invention solves the above" changed to

		"present invention can solve the above"
78	Change	"the above problems" changed to "the above-described problems"
79-80	Change	"problems and has as its...of the present" changed to "problems. For the...of the present"
81-82	Change	"“in front” means the focal point" changed to "“in front” can mean a focal point"
83-84	Change	"focal point side. ...the reference" changed to "focal point side, and the reference"
85-86	Change	"examples are shown in parentheses." changed to "examples are indicated in parentheses."
87-88	Change	"[0014] [1] A...a laser diode" changed to "[0015] Therefore, an...includes a laser diode"
89	Change	"laser beams, to be arranged" changed to "laser beams, adapted to be arranged"
90-91	Change	"two-dimensional array;" changed to "two-dimensional array. ...direction for every row."
92	Deletion	[0016] a first condenser...to the first direction;
93	Deletion	[0017] a first beam...direction for every row;
94-95	Change	"a second condenser" changed to "[0018] According to this...a second condenser"
96-97	Change	"second condenser (80) provided in" changed to "second condenser can be provided in"
98-99	Change	"beam converter (30),...collimating the group of" changed to "beam converter, which is...collimate the group of"
100	Change	"beam converter (30) in a second" changed to "beam converter in a second"
101-102	Change	"every row, and using each with center" changed to "every row, and configured to use each with center"
103-104	Change	"optical axes;" changed to "optical axes. In...first beam compressor."
105	Deletion	[0019] a first beam...plurality of rows; and
106	Deletion	[0020] a third condenser...beam compressor (40).
107	Deletion	[0021] [2] A...device provided with:
108-109	Change	"a laser diode" changed to "[0022] one ofAnother...array or a laser diode"
110-111	Change	"of emitters, extending long in a first" changed to "of emitters. The emitters can extend in a first"
112-113	Change	"laser beams, to be arranged" changed to "laser beams, and may be arranged"
114	Change	"direction and arranged in a plurality" changed to "direction and in a plurality"

115-116	Change	"beam elements arranged in...and emitting a group of" changed to "beam elements. The lase...may can emit a group of"
117-118	Change	"plurality of rows;" changed to "plurality of rows."
119	Deletion	[0023] a first condenser...to the first direction;
120-121	Change	"a first beam" changed to "[0024] A first condenser...include a first beam"
122	Change	"beam converter (30) provided in" changed to "beam converter provided in"
123-124	Change	"beams as units;" changed to "beams as units."
125-126	Change	"second condenser" changed to "[0025] aA second condenser"
127-128	Change	"second condenser (80) provided in" changed to "second condenser may be provided in"
129	Change	"beam converter (30) in a second" changed to "beam converter in a second"
130-131	Change	"optical axes;" changed to "optical axes. In...first beam compressor."
132	Deletion	[0026] a first beam...plurality of rows; and
133	Deletion	[0027] a third condenser...beam compressor (40).
134	Deletion	[0028] [3] A...device provided with:
135-136	Change	"a laser diode" changed to "[0029] Still another...include a laser diode"
137-138	Change	"laser beams, to be arranged linearly" changed to "laser beams, and capable...being arranged linearly"
139	Change	"plurality of rows and" changed to "plurality of rows, and"
140-141	Change	"and emitting a group of" changed to "and configured to emit a group of"
142-143	Change	"two-dimensional array;" changed to "two-dimensional array. A...direction for every row;"
144	Deletion	[0030] a first condenser...to the first direction;
145	Deletion	[0031] a first beam...direction for every row;
146	Deletion	[0032] a second condenser...direction for every row;
147	Deletion	[0033] a first beam...the plurality of rows;
148-149	Change	"provided in" changed to "[0034] an angle changerA...is also provided in"
150	Change	"second condenser (80) and the first" changed to "second condenser and the first"
151	Change	"compressor (40), receiving the" changed to "compressor (40), capable of receiving the"
152-153	Change	"of rows, and changing the center" changed to "of rows, and adapted to change the center"

154-155	Change	"same object; and" changed to "same object. Further, the...in center optical axes."
156	Deletion	[0035] a third condenser...in center optical axes.
157	Deletion	[0036] [4] A...device provided with:
158-159	Change	"a laser diode" changed to "[0037] one ofYet another...(i) a laser diode"
160-161	Change	"two-dimensional array and a laser diode" changed to "two-dimensional array, or (ii) a laser diode"
162-163	Change	"plurality of rows;" changed to "plurality of rows. A...group of laser beams."
164	Deletion	[0038] a first condenser...to the first direction;
165	Deletion	[0039] a first beam...of laser beams as units;
166	Deletion	[0040] a second condenser...direction for every row;
167	Deletion	[0041] a first beam...the plurality of rows;
168	Deletion	[0042] an angle changer...the same object; and
169	Deletion	[0043] a third condenser...group of laser beams.
170	Insertion	[0044] [5] A
171-172	Change	"semiconductor laser...one of the second" changed to "According to a further...invention, the second"
173-174	Change	"second condenser (80) and the first beam" changed to "second condenser or the first beam"
175-176	Change	"beam converter (40) and...are formed integrally" changed to "beam converter can be integrally"
177	Change	"integrally." changed to "integrally formed with the angle changer."
178	Deletion	[0045] [6] A...device provided with:
179	Deletion	[0046] a
180-181	Change	"laser diode" changed to "[0024] Yet another...include a laser diode"
182-183	Change	"stack array provided with a plurality of" changed to "stack array provided with a plurality of"
184-185	Change	"extending long in a first direction" changed to "extending long in a first direction"
186-187	Change	"laser beams, to be arranged linearly" changed to "laser beams, capable of being arranged linearly"
188-189	Change	"arranged linearly in the first direction" changed to "arranged linearly in the first direction"
190-191	Change	"first direction and arranged" changed to "first direction and arranged"
192-193	Change	"arranged in a plurality of" changed to "arranged in a plurality of"
194-195	Change	"plurality of rows and emitting a group" changed to "plurality of rows and emitting a group"

196-197	Change	"elements arranged in a two-dimensional" changed to "elements arranged in a two-dimensional"
198	Deletion	two-dimensional array;
199	Deletion	[0047] a
200	Change	"first condenser" changed to ". A first condenser"
201-202	Change	"first condenser (20)...front of the laser diode" changed to "first condenser may be...front of the laser diode"
203-204	Change	"stack array and bending" changed to "stack array and bending"
205-206	Change	"bending and collimating" changed to "bending and collimating"
207-208	Change	"for every row in a second direction" changed to "for every row in a second direction"
209	Deletion	first direction;
210	Deletion	[0048] a
211	Change	"first beam converter" changed to ". A first beam converter"
212-213	Change	"beam converter (30)...of the first condenser" changed to "beam converter may be...of the first condenser"
214-215	Change	"condenser (20), receiving...laser beams collimated" changed to "condenser, so as to...laser beams collimated"
216-217	Change	"collimated in the second direction," changed to "collimated in the second direction,"
218-219	Change	"second direction, and emitting it converted to" changed to "second direction, and emit the beams converted to"
220-221	Change	"beams extending in the first direction for" changed to "beams extending in the first direction for"
222	Deletion	for every row;
223	Deletion	[0049] a second condenser...the group of laser beams
224	Change	"output from" changed to ". A second condenser may...laser beams output from"
225-226	Change	"beam converter (30) in a...direction substantially" changed to "beam converter in a...direction substantially"
227	Deletion	for every row; and
228	Deletion	[0050] a
229	Change	"third condenser" changed to ". The laser device also...a third condenser"

230-231	Change	"third condenser (70) for...laser beams output from" changed to "third condenser adapted...laser beams output from"
232-233	Change	"second condenser (80), forming images," changed to "second condenser (80), forming images,"
234-235	Change	"forming images, and reduce the distance between" changed to "forming images, and reducing the distance between"
236	Deletion	[0051] [7] A...device provided with:
237	Deletion	[0052] one of
238-239	Change	"a laser diode" changed to "[0025] A firther...(i) a laser diode"
240-241	Change	"stack array provided with a plurality" changed to "stack array provided with a plurality"
242-243	Change	"extending long in a first direction" changed to "extending long in a first direction"
244-245	Change	"laser beams, to be arranged linearly" changed to "laser beams, capable of being arranged linearly"
246-247	Change	"arranged linearly in the first direction" changed to "arranged linearly in the first direction"
248-249	Change	"first direction and arranged" changed to "first direction and arranged"
250-251	Change	"arranged in a plurality of" changed to "arranged in a plurality of"
252-253	Change	"plurality of rows and...laser beams having laser" changed to "plurality of rows and...laser beams having laser"
254-255	Change	"elements arranged in a...laser beams comprised of" changed to "elements arranged in a...laser beams comprised of"
256	Deletion	linearly arranged in a plurality of rows;
257	Deletion	[0053] a first condenser...the group of laser beams
258	Insertion	in a plurality of rows;
259-260	Change	"for every row" changed to "[0026] The laser device...beams for every row"
261	Deletion	first direction;
262	Deletion	[0054] a first
263	Change	"beam converter" changed to ". A first beam converter"
264-265	Change	"beam converter (30)...of the first condenser" changed to "beam converter may be...of the first condenser"
266-267	Change	"condenser (20), dividing the" changed to "condenser, thus dividing the"

268-269	Change	"elements for bending the axes of the" changed to "elements for bending the axes of the"
270	Change	"laser beams, receiving the group of laser beams" changed to "laser beams,"
271	Change	"collimated in" changed to "receiving the group of laser beams collimated in"
272-273	Change	"optical element, and...beams as a substantially" changed to "optical element, and...beams as a substantially"
274	Deletion	beams as units;
275	Deletion	[0055] a second condenser...the group of laser beams
276	Change	"output from" changed to ". A second condenser may...laser beams output from"
277-278	Change	"beam converter (30) in a second direction" changed to "beam converter in a second direction"
279	Deletion	for every row; and
280	Deletion	[0056]
281	Change	"a third condenser" changed to ". Further, a third condenser"
282-283	Change	"third condenser (70) for...beams, forming images," changed to "third condenser may be...beams, forming images,"
284-285	Change	"forming images, and reducing the distance between" changed to "forming images, and reducing the distance between"
286	Deletion	[0057] [8] A...device provided with:
287	Deletion	[0058] a laser diode...a group of laser beams
288-289	Change	"having laser" changed to "[0027] Still further...laser beams having laser"
290-291	Change	"elements arranged in a two-dimensional" changed to "elements arranged in a two-dimensional"
292	Deletion	two-dimensional array;
293	Deletion	[0059] a first condenser...the group of laser beams
294	Change	"for every row" changed to ". A first condenser may...beams for every row"
295	Deletion	first direction;
296	Deletion	[0060] a first beam...the group of laser beams
297	Change	"" changed to ". A first beam converter...the group of laser beams"
298-299	Change	"second direction, and...to a substantially" changed to "second direction, and...to a substantially"
300	Deletion	for every row;

301	Deletion	[0061] a second condenser...the group of laser beams
302	Change	"output from" changed to ". A second condenser may...laser beams output from"
303	Change	"beam converter (30) in" changed to "beam converter in"
304-305	Change	"in a second direction" changed to "in a second direction"
306	Deletion	for every row;
307	Deletion	[0062] a
308	Change	"fourth condenser" changed to ". A fourth condenser"
309-310	Change	"fourth condenser (71)...of the second condenser" changed to "fourth condenser may be...of the second condenser"
311-312	Change	"second condenser (80),...the substantially" changed to "second condenser, and...the substantially"
313-314	Change	"beams extending in the...of rows, forming" changed to "beams extending in the...of rows, forming"
315-316	Change	"forming images, and reducing the distance between" changed to "forming images, and reducing the distance between"
317	Deletion	between rows; and
318	Deletion	[0063] a
319	Change	"third condenser" changed to ". The laser device can include a third condenser"
320-321	Change	"third condenser (70) for...and reforming the" changed to "third condenser for...and reforming the"
322	Deletion	fourth condenser (71).
323	Deletion	[0064] [9] A...device provided with:
324	Deletion	[0065] one of a laser...comprised of laser beams
325	Insertion	.
326-327	Change	"substantially" changed to "[0028] Yet another...beams substantially"
328	Deletion	linearly arranged in a plurality of rows;
329	Deletion	[0066] a first condenser...beams for every row in a
330	Change	"second direction" changed to "in a plurality of rows. ...in a second direction"
331	Deletion	first direction;
332	Deletion	[0067] a
333	Change	"first beam" changed to ". A first beam"
334-335	Change	"beam converter (30)...the group of laser"

		changed to "beam converter may be...the group of laser"
336	Change	"laser beams in each row" changed to "laser beams in each row, providing in each row"
337	Change	"in each row, providing in" changed to "in each row in"
338	Change	"in each row in parallel optical" changed to "in parallel optical"
339-340	Change	"elements for bending the axes of the" changed to "elements for bending the axes of the"
341-342	Change	"laser beams, receiving the group of laser" changed to "laser beams, receiving the group of laser"
343-344	Change	"beams collimated in the second direction," changed to "beams collimated in the second direction,"
345-346	Change	"optical element, and...beams as a substantially" changed to "optical element, and...beams as a substantially"
347-348	Change	"beams extending in the first direction using" changed to "beams extending in the first direction using"
349	Deletion	pluralities of laser beams as units;
350	Deletion	[0068] a second condenser...and collimating the
351	Insertion	beams as units.
352-353	Change	"group of laser" changed to "[0029] The laser device...the group of laser"
354-355	Change	"beam converter (30) in a second direction" changed to "beam converter in a second direction"
356-357	Change	"right angles to the first direction" changed to "right angles to the first direction"
358	Deletion	for every row;
359	Deletion	[0069] a fourth condenser...between rows; and
360	Deletion	[0070] a third condenser...fourth condenser (71).
361	Insertion	. A fourth condenser may...the fourth condenser.
362	Insertion	[0071] [10] A
363-364	Change	"semiconductor laser...with an angle changer" changed to "According one exemplary...an angle changer"
365	Change	"angle changer provided at" changed to "angle changer may also be provided at"
366	Deletion	[0072] [11] A...device provided with:
367-368	Insertion	[0031] A further...direction for every row.
369-370	Insertion	[0032] A second condenser...the plurality of rows.
371-372	Insertion	[0033] The laser device...the fourth condenser.

373-374	Change	"a laser diode" changed to "[0073] Another exemplary...(i) a laser diode"
375	Change	"laser beams, to be arranged linearly" changed to "laser beams, arranged linearly"
376	Change	"plurality of rows and" changed to "plurality of rows, and"
377	Change	"and emitting a" changed to "and capable of emitting a"
378-379	Change	"two-dimensional array;" changed to "two-dimensional array or...direction for every row."
380	Deletion	[0074] a first condenser...to the first direction;
381	Deletion	[0075] a first beam...direction for every row;
382	Deletion	[0076] a second condenser...direction for every row;
383	Deletion	[0077] a first beam...the group of laser beams
384-385	Change	"output from" changed to "[0035] The laser device...laser beams output from"
386-387	Change	"second condenser (80) and...compressed substantially" changed to "second condenser and emit...compressed substantially"
388	Deletion	plurality of rows;
389	Deletion	[0078] a
390	Change	"second beam" changed to ". A second beam"
391-392	Change	"compressor (112, 113) provided in front of the" changed to "compressor may be provided in front of the"
393-394	Change	"beam compressor (110,...laser beams output from" changed to "beam compressor, and...laser beams output from"
395-396	Change	"beam compressor (110,...with shortened intervals" changed to "beam compressor converted...with shortened intervals"
397	Deletion	plurality of rows;
398	Deletion	[0079] a
399	Change	"fourth condenser" changed to ". A fourth condenser"
400-401	Change	"fourth condenser (60) for...the beams output from" changed to "fourth condenser may be...the beams output from"
402-403	Change	"beam compressor (113) and making the beam" changed to "beam compressor, and making the beam"
404	Deletion	second direction; and
405	Deletion	[0080] a
406	Change	"third condenser" changed to ". Further, a third

		condenser"
407-408	Change	"third condenser (70) for condensing the" changed to "third condenser may be...for condensing the"
409	Deletion	fourth condenser (60).
410	Deletion	[0081] [12] A...device provided with:
411	Deletion	[0082] one of a laser diode stack array provided
412	Insertion	.
413-414	Change	"with a plurality" changed to "[0036] A still further...with a plurality"
415-416	Change	"of rows and emitting a...laser beams having laser" changed to "of rows and emitting a...laser beams having laser"
417	Deletion	two-dimensional array and...in a plurality of rows;
418	Deletion	[0083] a first condenser (20) provided in
419	Change	"front of the" changed to ". A first condenser may...provided in front of the"
420	Deletion	stack array and bending...to the first direction;
421	Deletion	[0084] a first beam converter (30) provided in
422	Change	"front of the" changed to ", and adapted for bending...provided in front of the"
423-424	Change	"first condenser (20),...beams collimated in" changed to "first condenser, and...beams collimated in"
425-426	Change	"direction, rotating the...ladder rung" changed to "direction, and emitting...ladder rung"
427	Deletion	first direction using the...of laser beams as units;
428	Deletion	[0085] a second condenser (80) provided in
429	Change	"front of the" changed to "for every row. A second...provided in front of the"
430-431	Change	"beam converter (30) and...laser beams output from" changed to "beam converter, and...laser beams output from"
432	Deletion	beam converter (30) in a...direction for every row;
433	Deletion	[0086] a first beam...the group of laser beams
434	Insertion	(30) in a second...direction for every row.
435-436	Change	"output from" changed to "[0037] The laser device...laser beams output from"
437-438	Change	"second condenser (80) and" changed to "second condenser, and"
439-440	Change	"and emitting it converted into" changed to "and emitting the beams converted into"
441-442	Change	"converted into a compressed substantially" changed to "converted into a compressed substantially"
443	Change	"laser beams extending in" changed to "laser

		beams with...and extending in"
444	Deletion	plurality of rows;
445	Deletion	[0087] a second
446	Change	"beam compressor" changed to ". A second beam compressor"
447-448	Change	"compressor (112, 113) provided in front of the" changed to "compressor may be provided in front of the"
449-450	Change	"beam compressor (110,...beams with shortened" changed to "beam compressor, and...beams with shortened"
451	Deletion	the rows and compressed...the plurality of rows;
452	Deletion	[0088] a fourth condenser...second direction; and
453	Deletion	[0089] a third condenser (70) for
454	Change	"condensing the" changed to "extending in the second...for condensing the"
455	Deletion	laser beams output from...fourth condenser (60).
456	Deletion	[0090] [13] A...device provided with:
457	Deletion	[0091] a laser
458	Insertion	.
459-460	Change	"diode stack" changed to "[0038] Another exemplary...(i) a laser diode stack"
461-462	Change	"array provided with a plurality of" changed to "array provided with a plurality of"
463-464	Change	"extending long in a first direction of" changed to "extending long in a first direction of"
465-466	Change	"laser beams, to be arranged linearly" changed to "laser beams, which may be arranged linearly"
467-468	Change	"arranged in a plurality of" changed to "arranged in a plurality of"
469-470	Change	"plurality of rows and...laser beams having laser" changed to "plurality of rows, and...laser beams having laser"
471	Deletion	having laser beam...a two-dimensional array;
472	Deletion	[0092] a first condenser (20) provided in
473	Change	"front of the" changed to "beam elements arranged in...provided in front of the"
474	Deletion	stack array and bending...to the first direction;
475	Deletion	[0093] a first beam...the group of laser beams
476	Change	"collimated in" changed to ", and adapted for bending...beams collimated in"
477-478	Change	"direction, and emitting...rung configuration" changed to "direction, rotating the...rung configuration"
479	Deletion	first direction for every row;

480	Deletion	[0094] a second condenser (80) provided in
481	Insertion	using the divided...of laser beams as units;
482-483	Change	"front of the" changed to "[0039] The laser device...provided in front of the"
484	Deletion	beam converter (30) and...direction for every row;
485	Deletion	[0095] a first beam...it converted into a
486	Change	"compressed substantially" changed to ", so as to bend and...compressed substantially"
487-488	Change	"laser beams with...the first direction of" changed to "laser beams extending in the first direction of"
489	Deletion	plurality of rows;
490	Deletion	[0096] a second
491	Insertion	.
492-493	Change	"beam compressor" changed to "[0040] The exemplary...a second beam compressor"
494-495	Change	"compressor (152, 153) provided in front of the" changed to "compressor provided in front of the"
496-497	Change	"beam compressor (150,...into a compressed group" changed to "beam compressor, and...into a compressed group"
498-499	Change	"laser beams with shortened intervals of" changed to "laser beams with shortened intervals of"
500-501	Change	"of the rows and extending...the second direction of" changed to "of the rows and extending...the second direction of"
502	Deletion	plurality of rows;
503	Deletion	[0097] an angle changer...(150, 151) and
504	Change	"changing the" changed to ". An angle changer may...and changing the"
505	Deletion	axis angles; and
506	Deletion	[0098] a third condenser (70) for
507	Change	"condensing the" changed to ". Further, a third...for condensing the"
508	Deletion	laser beams.
509	Deletion	[0099] [14] A...device provided with:
510	Deletion	[0100] one of a laser...in a plurality of rows;
511	Deletion	[0101] a first condenser...to the first direction;
512	Deletion	[0102] a first beam...of laser beams as units;
513	Deletion	[0103] a second condenser...direction for every row;
514	Deletion	[0104] a first beam...the plurality of rows;
515	Deletion	[0105] a second beam...the plurality of rows;
516	Deletion	[0106] an angle changer...optical axis angles; and
517	Deletion	[0107] a third condenser...group of laser beams.

518	Deletion	[0108] [15] A...second beam compressor.
519	Insertion	.
520-521	Change	"a second beam" changed to "[0109] [16] A...addition, a second beam"
522-523	Change	"beam converter (50) provided between" changed to "beam converter may be provided between"
524	Change	"compressor, receiving the" changed to "compressor, which is capable of receiving the"
525-526	Change	"result emitting it converted to" changed to "result emitting the beams converted to"
527	Insertion	second direction....the same object.
528	Deletion	[0110] [17] A...further provided with:
529	Deletion	[0111] a second beam...the second direction and
530	Deletion	[0112] an angle changer...the same object.
531-532	Change	"a fifth condenser" changed to "[0113] [18]A...a fifth condenser"
533-534	Change	"fifth condenser (154) provided between" changed to "fifth condenser may be provided between"
535	Change	"converter, receiving the" changed to "converter, which is capable of receiving the"
536-537	Change	"and emitting it bending and" changed to "and emitting the beams, and bending and"
538	Insertion	of each row. The fifth...be a cylindrical lens.
539	Deletion	[0114] [19] A...is a cylindrical lens.
540	Insertion	[0115] [20] A...provided with a shifter
541-542	Change	"provided between the...the second condenser and" changed to "In addition, a shifter...the second condenser and"
543-544	Change	"and shifting in parallel...direction for each row." changed to "and shifting in parallel...of cylindrical lenses."
545	Deletion	[0116] [21] A...direction for each row.
546	Deletion	[0117] [22] A...of cylindrical lenses.
547	Deletion	[0118] [23] A...device provided with:
548-549	Change	"a laser diode" changed to "[0119] A further...include a laser diode"
550-551	Change	"laser beams, to be arranged linearly" changed to "laser beams, capable of being arranged linearly"
552-553	Change	"two-dimensional array;" changed to "two-dimensional array. A...in the second direction."
554	Deletion	[0120] a first condenser...to the first direction;
555	Deletion	[0121] a second beam...in the second direction;
556-557	Change	"a first beam" changed to "[0122] This exemplary...include a first beam"
558	Change	"beam converter (50) provided in" changed to

		"beam converter provided in"
559	Change	"beam compressor (112, 113)," changed to "beam compressor,"
560	Change	", dividing the" changed to ", configured for dividing the"
561-562	Change	"beams as units;" changed to "beams as units. A first...group of laser beams."
563	Deletion	[0123] a first beam...in the first direction;
564	Deletion	[0124] a second condenser...second direction; and
565	Deletion	[0125] a third condenser...group of laser beams.
566	Deletion	[0126] [24] A...device provided with:
567-568	Change	"a laser diode" changed to "[0127] one ofStill a...(i) a laser diode"
569	Change	"laser beams, to be arranged" changed to "laser beams, adapted to be arranged"
570-571	Change	"two-dimensional array and a laser diode" changed to "two-dimensional array, or (ii) a laser diode"
572-573	Change	"laser beams, to be arranged" changed to "laser beams, adapted be arranged"
574-575	Change	"plurality of rows;" changed to "plurality of rows. A...to the first direction;"
576	Deletion	[0128] a first condenser...to the first direction;
577	Deletion	[0129] a second beam...in the second direction;
578-579	Change	"provided in" changed to "[0130] a first beam...may be provided in"
580	Change	"beam compressor (112, 113)," changed to "beam compressor,"
581	Change	", dividing the" changed to ", capable of dividing the"
582-583	Change	"beams as units;" changed to "beams as units. A first...in the first direction."
584	Deletion	[0131] a first beam...in the first direction;
585-586	Change	"a second condenser" changed to "[0132] The exemplary...a second condenser"
587	Change	"second condenser (60) provided in" changed to "second condenser provided in"
588-589	Change	"beam compressor (110, 111) and" changed to "beam compressor, and"
590	Change	"and making the" changed to "and adapted for making the"
591-592	Change	"second direction; and" changed to "second direction. A third...group of laser beams."
593	Deletion	[0133] a third condenser...group of laser beams.
594-595	Change	"a fifth condenser" changed to "[0134] [25]A...a

		fifth condenser"
596-597	Change	"fifth condenser (155) provided between" changed to "fifth condenser may be provided between"
598	Change	"beam converter, receiving a" changed to "beam converter, which is adapted for receiving a"
599	Change	"second direction." changed to "second direction. The...type reflection mirror."
600	Deletion	[0135] [26] A...is a cylindrical lens.
601	Deletion	[0136] [27] A...the same object.
602	Deletion	[0137] [28] A...array of wedge prisms.
603	Deletion	[0138] [29] A...of cylindrical lenses.
604	Deletion	[0139] [30] A...type reflection mirror.
605	Deletion	[0140] [31] A...anamorphic prism pair.
606	Deletion	[0141] [32] A...two-dimensional lenses.
607	Deletion	[0142] [33] A...parabolic mirror.
608	Deletion	[0143] [34] A...of cylindrical lenses.
609-610	Change	"provided" changed to "[0144] [35] A...adjuster may be provided"
611	Change	"provided, in front of" changed to "provided in front of"
612-613	Change	"condenser, with an angle adjuster" changed to "condenser, the angle adjuster"
614	Change	"angle adjuster for finely" changed to "angle adjuster being adapted for finely"
615	Insertion	second direction. The...least one wedge plate.
616	Deletion	[0145] [36] A...least one wedge plate.
617	Deletion	[0146] [37] A...each provided with:
618	Deletion	[0147] a receiving part...axes as first axes,
619	Deletion	[0148] an optical system...right angles, and
620	Deletion	[0149] an emission part...the optical system,
621-622	Change	"" changed to "[0150] theEach of the...axes as first axes,"
623	Change	"" changed to "an optical system for...right angles, and"
624	Change	"optical elements" changed to "an emission part for... The optical elements"
625	Deletion	[0151] [38] A...to the horizontal plane.
626-627	Change	"a prism comprised" changed to "[0152] [39] A...may be a prism comprised"
628-629	Change	"optical glass" changed to "[0153] [40] A...of anAn optical glass"
630-631	Change	"glass member having parallel first" changed to "glass member may be...have parallel first"
632-633	Change	"extend of 60°, formed continuously" changed to

		"extend of 60°. The...be formed continuously"
634	Change	"reflecting face," changed to "reflecting face. In addition or alternatively,"
635	Change	", and a one-dimensional" changed to ", a one-dimensional"
636	Change	"one-dimensional array comprised of" changed to "one-dimensional array may...which is comprised of"
637-638	Change	"mirror structure" changed to "[0154] [41] A...of aA mirror structure"
639	Change	"mirror structure having a first" changed to "mirror structure may also...provided having a first"
640-641	Change	"extend of 60°, formed continuously" changed to "extend of 60°. The...be formed continuously"
642	Change	"reflecting face," changed to "reflecting face. Alternatively or in addition,"
643	Change	", and a one-dimensional" changed to ", a one-dimensional"
644	Change	"one-dimensional array comprised of" changed to "one-dimensional array may...which is comprised of"
645	Deletion	[0155] [42] A...predetermined distance.
646-647	Change	"comprised of" changed to "[0156] [43] A...may also be comprised of"
648	Insertion	predetermined distance....incidence side lenses.
649	Deletion	[0157] [44] A...incidence side lenses.
650-651	Change	"optical element" changed to "[0158] [45] A...theThe optical element"
652-653	Change	"optical element is a cylindrical" changed to "optical element may also be a cylindrical"
654	Insertion	optical axis. The beam...incidence side lenses.
655	Deletion	[0159] [46] A...incidence optical axis.
656	Deletion	[0160] [47] A...incidence side lenses.
657-658	Change	"beam converter" changed to "[0161] [48] A...theThe beam converter"
659-660	Change	"beam converter is comprised of" changed to "beam converter may be comprised of"
661	Change	"cross-section." changed to "cross-section. In the...90° in cross-section."
662	Deletion	[0162] [49] A...90° in cross-section.
663	Deletion	[0163] [50] A...inclined by about 45°.
664	Deletion	[0164] [51] A...axes inclined about 45°.
665-666	Change	"comprised of," changed to "[0165] [52] A...also be comprised of,"
667	Deletion	[0166] [53] A...to a horizontal plane.

668	Deletion	[0167] [54] A...to a horizontal plane.
669-670	Change	"comprised of" changed to "[0168] [55] A...may also be comprised of"
671	Deletion	[0169] [56] A...front of the condensers.
672	Deletion	[0170] [57] A...after the condenser.
673-674	Change	"least three" changed to "[0171] [58] A...At least three"
675	Change	"stack arrays provided with" changed to "stack arrays may be provided with"
676	Insertion	the condenser. The...a dichroic mirror.
677	Deletion	[0172] [59] A...a polarization element.
678	Deletion	[0173] [60] A...laser diode stack array.
679	Deletion	[0174] [61] A...laser diode stack array.
680	Deletion	[0175] [62] A...laser diode stack array.
681	Deletion	[0176] [63] A...is a dichroic mirror.
682	Deletion	[0177] [64] A...of the third condenser.
683	Deletion	[0178] [65] A...a rare earth element.
684	Deletion	[0179] [66] A...of the third condenser.
685-686	Change	"an optical" changed to "[0180] [67] A...may include an optical"
687	Change	"set forth in [64] so as to converge" changed to "set forth in so as to converge"
688	Insertion	focal point. The optical...a rare earth element.
689	Deletion	[0181] [68] A...a rare earth element.
690	Deletion	[0182] The semiconductor...or medical applications.
691-692	Change	"" changed to "[0183] The semiconductor...or medical applications."
693-694	Change	"laser device using a beam converter" changed to "laser device may use a beam converter"
695	Change	"beam converter of the present" changed to "beam converter of an...of the present"
696	Change	"[0184] Further, the...semiconductor lasers" changed to ""
697	Change	"and obtain" changed to "Further, the...lasers, and obtain"
698	Change	"FIG. 1 is a" changed to "[0185] FIG. 1 is a"
699	Change	"FIG. 2 is a" changed to "[0186] FIG. 2 is a"
700	Change	"FIG. 3 is a" changed to "[0187] FIG. 3 is a"
701	Change	"lens with a focal length" changed to "lens with a particular focal length"
702	Change	"focal length f." changed to "focal length."
703	Change	"FIG. 4 is a" changed to "[0188] FIG. 4 is a"
704	Change	"FIG. 5 is a" changed to "[0189] FIG. 5 is a"

705	Change	"imaginary object O placed on the" changed to "imaginary object placed on the"
706	Change	"FIG. 6 is a" changed to "[0190] FIG. 6 is a"
707	Change	"FIG. 7 is a" changed to "[0191] FIG. 7 is a"
708	Change	"view of an embodiment of" changed to "view of an exemplary embodiment of"
709-710	Change	"laser device of the present" changed to "laser device according to the present"
711	Change	"FIG. 8 is an" changed to "[0192] FIG. 8 is an"
712-713	Change	"elevation view of a semiconductor" changed to "elevation view of an exemplary semiconductor"
714	Change	"FIG. 9 is a" changed to "[0193] FIG. 9 is a"
715-716	Change	"plan view of a semiconductor" changed to "plan view of an exemplary semiconductor"
717	Change	"FIG. 10 is an" changed to "[0194] FIG. 10 is an"
718	Change	"FIG. 11 is a" changed to "[0195] FIG. 11 is a"
719-720	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
721-722	Change	"laser device of the present" changed to "laser device according to the present"
723-724	Change	"present invention using transparent" changed to "present invention that uses transparent"
725	Change	"FIG. 12 is an" changed to "[0196] FIG. 12 is an"
726	Change	"FIG. 13 is a" changed to "[0197] FIG. 13 is a"
727-728	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
729-730	Change	"laser device of the present" changed to "laser device according to the present"
731	Change	"FIG. 14 is an" changed to "[0198] FIG. 14 is an"
732	Change	"FIG. 15 is a" changed to "[0199] FIG. 15 is a"
733-734	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
735-736	Change	"laser device of the present" changed to "laser device according to the present"
737-738	Change	"present invention using a cylindrical" changed to "present invention that uses a cylindrical"
739	Change	"FIG. 16 is an" changed to "[0200] FIG. 16 is an"
740-741	Change	"shown in FIG. 15" changed to "shown in FIG. 15."
742	Change	"FIG. 17 is a" changed to "[0201] FIG. 17 is a"
743-744	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
745-746	Change	"laser device of the present" changed to "laser device according to the present"
747	Change	"FIG. 18 is an" changed to "[0202] FIG. 18 is an"

748	Change	"FIGS. 19A to" changed to "[0203] FIGS. 19A to"
749-750	Change	"19C are views for explaining the state of" changed to "19C are views illustrating the state of"
751	Change	"FIG. 20 is a" changed to "[0204] FIG. 20 is a"
752-753	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
754-755	Change	"laser device of the present" changed to "laser device according to the present"
756	Change	"FIG. 21 is an" changed to "[0205] FIG. 21 is an"
757	Change	"FIG. 22 is a" changed to "[0206] FIG. 22 is a"
758-759	Change	"a side view for explaining a semiconductor" changed to "a side view illustrating the semiconductor"
760	Change	"FIG. 23 is a" changed to "[0207] FIG. 23 is a"
761-762	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
763-764	Change	"laser device of the present" changed to "laser device according to the present"
765-766	Change	"present invention using two one-dimensional" changed to "present invention that uses two one-dimensional"
767	Change	"FIG. 24 is a" changed to "[0208] FIG. 24 is a"
768-769	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
770-771	Change	"laser device of the present" changed to "laser device according to the present"
772-773	Change	"present invention using two one-dimensional" changed to "present invention that uses two one-dimensional"
774	Change	"FIG. 25 is an" changed to "[0209] FIG. 25 is an"
775	Change	"FIGS. 26A and" changed to "[0210] FIGS. 26A and"
776	Change	"FIG. 27 is a" changed to "[0211] FIG. 27 is a"
777-778	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
779-780	Change	"laser device of the present" changed to "laser device according to the present"
781-782	Change	"present invention using a telescope" changed to "present invention that uses a telescope"
783	Change	"FIG. 28 is an" changed to "[0212] FIG. 28 is an"
784	Change	"FIGS. 29A and" changed to "[0213] FIGS. 29A and"
785	Change	"FIG. 30 is a" changed to "[0214] FIG. 30 is a"

786	Change	"FIG. 31 is a" changed to "[0215] FIG. 31 is a"
787	Change	"FIG. 32 is a" changed to "[0216] FIG. 32 is a"
788-789	Change	"is a view of a semiconductor" changed to "is a view of an exemplary...of the semiconductor"
790-791	Change	"laser device arranging a cylindrical" changed to "laser device according to...provides a cylindrical"
792	Change	"cylindrical lens (fifth condenser)" changed to "cylindrical lens (e.g., a fifth condenser)"
793	Change	"FIG. 33 is a" changed to "[0217] FIG. 33 is a"
794	Change	"FIG. 34 is a" changed to "[0218] FIG. 34 is a"
795	Change	"of another semiconductor" changed to "of another exemplary...of the semiconductor"
796-797	Change	"laser device arranging a cylindrical" changed to "laser device providing the cylindrical"
798	Change	"cylindrical lens (fifth condenser)" changed to "cylindrical lens (e.g., the fifth condenser)"
799	Change	"FIG. 35 is a" changed to "[0219] FIG. 35 is a"
800-801	Change	"35 is a view for explaining an optical" changed to "35 is a view illustrating an optical"
802	Change	"FIG. 36 is a" changed to "[0220] FIG. 36 is a"
803	Change	"FIGS. 37A and" changed to "[0221] FIGS. 37A and"
804-805	Change	"37B are views for explaining the action of the" changed to "37B are views illustrating an action of the"
806	Change	"FIG. 38 is a" changed to "[0222] FIG. 38 is a"
807	Change	"FIG. 39 is a" changed to "[0223] FIG. 39 is a"
808	Change	"of another semiconductor" changed to "of another exemplary...of the semiconductor"
809-810	Change	"laser device arranging a cylindrical" changed to "laser device providing the cylindrical"
811	Change	"cylindrical lens (fifth condenser)" changed to "cylindrical lens (e.g., the fifth condenser)"
812	Change	"FIG. 40 is a" changed to "[0224] FIG. 40 is a"
813-814	Change	"perspective view of a semiconductor" changed to "perspective view of an...of the semiconductor"
815-816	Change	"laser device of the present" changed to "laser device according to the present"
817-818	Change	"present invention using segment type" changed to "present invention that uses segment type"
819-820	Change	"mirrors as the means for changing" changed to "mirrors as a way for changing"
821	Change	"FIG. 41 is a" changed to "[0225] FIG. 41 is a"
822	Change	"FIG. 42 is a" changed to "[0226] FIG. 42 is a"
823	Change	"FIG. 43 is a" changed to "[0227] FIG. 43 is a"

824	Change	"laser device of the present" changed to "laser device according to...of the present"
825	Change	"FIG. 44 is a" changed to "[0228] FIG. 44 is a"
826	Change	"FIG. 45 is a" changed to "[0229] FIG. 45 is a"
827-828	Change	"plan view of a semiconductor" changed to "plan view of an exemplary...of the semiconductor"
829-830	Change	"laser device of the present" changed to "laser device according to the present"
831-832	Change	"present invention using an optical" changed to "present invention that uses an optical"
833	Change	"FIG. 46 is a" changed to "[0230] FIG. 46 is a"
834	Change	"FIG. 47 is a" changed to "[0231] FIG. 47 is a"
835	Change	"laser device of the present" changed to "laser device according to...of the present"
836	Change	"FIG. 48 is a" changed to "[0232] FIG. 48 is a"
837-838	Change	"elevation view for explaining an optical fiber" changed to "elevation view illustrating the optical fiber"
839	Change	"FIG. 49 is a" changed to "[0233] FIG. 49 is a"
840-841	Change	"schematic plan view for...the semiconductor" changed to "schematic plan view...the semiconductor"
842	Change	"FIG. 50 is a" changed to "[0234] FIG. 50 is a"
843-844	Change	"elevation view for explaining the semiconductor" changed to "elevation view illustrating the semiconductor"
845	Change	"FIG. 51 is a" changed to "[0235] FIG. 51 is a"
846-847	Change	"schematic view for explaining a first beam" changed to "schematic view illustrating a first beam"
848	Change	"beam converter of the present" changed to "beam converter according...of the present"
849	Change	"FIG. 52 is a" changed to "[0236] FIG. 52 is a"
850-851	Change	"52 is a view for explaining the principle of" changed to "52 is a view illustrating a principle of"
852	Change	"FIG. 53 is a" changed to "[0237] FIG. 53 is a"
853	Change	"FIG. 54 is a" changed to "[0238] FIG. 54 is a"
854	Change	"FIG. 55 is a" changed to "[0239] FIG. 55 is a"
855	Change	"FIG. 56 is a" changed to "[0240] FIG. 56 is a"
856	Change	"FIG. 57 is a" changed to "[0241] FIG. 57 is a"
857	Change	"FIG. 58 is a" changed to "[0242] FIG. 58 is a"
858	Change	"FIG. 59 is a" changed to "[0243] FIG. 59 is a"
859	Change	"FIG. 60 is a" changed to "[0244] FIG. 60 is a"
860	Change	"FIG. 61 is a" changed to "[0245] FIG. 61 is a"

861	Change	"FIG. 62 is a" changed to "[0246] FIG. 62 is a"
862	Change	"FIG. 63 is a" changed to "[0247] FIG. 63 is a"
863	Change	"FIG. 64 is a" changed to "[0248] FIG. 64 is a"
864	Change	"FIG. 65 is a" changed to "[0249] FIG. 65 is a"
865	Change	"FIG. 66 is a" changed to "[0250] FIG. 66 is a"
866	Change	"FIG. 67 is a" changed to "[0251] FIG. 67 is a"
867	Change	"FIG. 68 is a" changed to "[0252] FIG. 68 is a"
868	Change	"FIG. 69 is a" changed to "[0253] FIG. 69 is a"
869	Change	"FIG. 70 is a" changed to "[0254] FIG. 70 is a"
870	Change	"FIG. 71 is a" changed to "[0255] FIG. 71 is a"
871	Change	"FIG. 72 is a" changed to "[0256] FIG. 72 is a"
872	Change	"FIG. 73 is a" changed to "[0257] FIG. 73 is a"
873	Change	"FIG. 74 is a" changed to "[0258] FIG. 74 is a"
874	Change	"FIG. 75 is a" changed to "[0259] FIG. 75 is a"
875	Change	"FIG. 76 is a" changed to "[0260] FIG. 76 is a"
876	Change	"FIG. 77 is a" changed to "[0261] FIG. 77 is a"
877	Change	"FIG. 78 is a" changed to "[0262] FIG. 78 is a"
878	Change	"FIG. 79 is a" changed to "[0263] FIG. 79 is a"
879	Change	"components (escape components)" changed to "components (e.g., escape components)"
880	Change	"FIG. 80 is a" changed to "[0264] FIG. 80 is a"
881	Change	"FIG. 81 is a" changed to "[0265] FIG. 81 is a"
882	Change	"FIGS. 82A and" changed to "[0266] FIGS. 82A and"
883	Change	"FIGS. 83A and" changed to "[0267] FIGS. 83A and"
884	Change	"FIGS. 84A and" changed to "[0268] FIGS. 84A and"
885	Change	"FIG. 85 is a" changed to "[0269] FIG. 85 is a"
886	Change	"DESCRIPTION" changed to "DETAILED DESCRIPTION"
887	Deletion	DESCRIPTION OF THE PREFERRED EMBODIMENTS
888-889	Change	"that a laser" changed to "[0270] The factIt has...herein that a laser"
890-891	Change	"the slow axis was...above. In the present" changed to "the slow axis. According...of the present"
892-893	Change	"the technique is adopted of rotating the beams by" changed to "the technique may be used...rotates the beams by"
894-895	Change	"each axis. Due to this, it is possible" changed to "each axis. Using such technique, it is possible"
896	Change	"Further, the" changed to "[0271] Further, the"

897-898	Change	"stack array forms a planar light" changed to "stack array may form a planar light"
899	Change	"FIG. 3 shows" changed to "[0272] FIG. 3 shows"
900-901	Change	"shown. In this case, all beams" changed to "shown. In such case, all beams"
902	Deletion	[0273] On the other hand,...center axis of the lens.
903-904	Change	"" changed to "[0274] On the other hand,...center axis of the lens."
905-906	Change	"FIG. 4. For simplification, the case of" changed to "FIG. 4. For the purpose...simplicity, the case of"
907-908	Change	"using candles. The fact...that beams emitted from" changed to "using candles. Beams emitted from"
909-910	Change	"corresponds to the case of FIG. 4." changed to "corresponds to the arrangement of FIG. 4."
911-912	Change	"light intensity can be obtained" changed to "light intensity would likely be obtained"
913	Change	"be obtained and it is" changed to "be obtained, and it is"
914	Change	"and it is not possible" changed to "and it is likely not possible"
915-916	Change	"beams" changed to "[0275] Regarding this...regarding beams"
917	Change	"beams emitted from" changed to "beams being emitted from"
918	Change	"optical fibers and" changed to "optical fibers, and"
919-920	Change	"and disclosed his findings" changed to "and the findings"
921	Change	"findings in Japanese" changed to "findings described in Japanese"
922	Change	"in Japanese Unexamined Patent Publication" changed to "in Japanese Patent Publication"
923	Change	"Publication (Kokai) No." changed to "Publication No."
924-925	Change	"No. 2001-255491. Its...in the following two" changed to "No. 2001-255491, the... The following two"
926	Change	"two methods." changed to "two methods have been...publication."
927-928	Change	"beams" changed to "[0276] That is, one...giving all(i) All beams"
929	Change	"beams predetermined" changed to "beams are given predetermined"
930-931	Change	"condensing lens. That is, as shown in" changed

		to "condensing lens. In particular, as shown in"
932	Insertion	of the lens. FIG. 5 shows...angles such as lasers.
933	Deletion	[0277] FIG. 5 shows the...angles such as lasers.
934-935	Change	"operation" changed to "[0278] The other...an(ii) An operation"
936	Change	"operation for reducing" changed to "operation is performed for reducing"
937	Change	"with need, reducing and" changed to "with need, and"
938	Change	"and reforming an image" changed to "and an image"
939	Change	"an image so as to form" changed to "an image is reduced and reformed so as to form"
940-941	Change	"two beams for simplification." changed to "two beams for the purpose of simplicity."
942-943	Change	"that combining" changed to "[0279] NoteIt should be noted that combining"
944-945	Change	"two methods is more effective." changed to "two methods can be more effective."
946	Change	"In the case" changed to "[0280] In the case"
947	Change	"of the above Japanese" changed to "of the above-identified Japanese"
948-949	Change	"Japanese Unexamined...works effectively." changed to "Japanese may work effectively."
950-951	Change	"stack intervals is difficult." changed to "stack intervals may be difficult."
952	Change	"Therefore," changed to "[0281] Therefore,"
953	Change	"Therefore, the inventors...studied methods for" changed to "Therefore, methods for"
954	Change	"in distance. As a result," changed to "in distance have been reviewed. As a result,"
955	Change	"As a result, they discovered various" changed to "As a result, various"
956	Change	"various specific methods such" changed to "various methods such"
957	Change	"methods such as introduction" changed to "methods such as the introduction"
958-959	Change	"a compressor." changed to "a compressor have been uncovered."
960	Deletion	[0282] Below, the gist of...the attached drawings.
961	Deletion	[0283] FIG. 7 is a plan...diode" are synonymous.
962-963	Change	"The semiconductor" changed to "[0284] FIG. 7 is a plan... The semiconductor"
964-965	Change	"stack array 10 is comprised of" changed to "stack array 10 of FIG. 7 may be comprised of"

966	Change	"of 10 to 100 (in FIG. 7,...six) active layer" changed to "of 10 to 100 active layer"
967	Change	"laser beams arranged in" changed to "laser beams (in FIG. 7,...is six) arranged in"
968	Change	"The cross-section" changed to "[0285] The cross-section"
969-970	Change	"(hereinafter called the “slow axis" changed to "(hereinafter referred to as a “slow axis"
971-972	Change	"(hereinafter called the “fast axis" changed to "(hereinafter referred to as a “fast axis"
973	Deletion	[0286] The active layer...a two-dimensional array.
974-975	Change	"" changed to "[0287] The active layer...a two-dimensional array."
976	Deletion	[0288] The first beam...active layer stripes.
977-978	Change	"" changed to "[0289] The first beam...active layer stripes."
979	Change	"Since laser" changed to "[0290] Since laser"
980	Change	"The second cylindrical" changed to "[0291] The second cylindrical"
981	Deletion	[0292] The beam...laser stack array.
982-983	Change	"" changed to "[0293] The beam...laser stack array."
984	Change	"Further, the" changed to "[0294] Further, the"
985	Deletion	[0295] However, the size...the beam compressor 40.
986-987	Change	"" changed to "[0296] However, the size...the beam compressor 40."
988	Change	"[0297] Regarding the slow...lens array 80 is 400" changed to ""
989-999	Change	"m, the image becomes 133...welding of metal." changed to "Regarding the slow axis...welding of metal."
1000	Change	"If not allowing" changed to "[0298] If not allowing"
1001-1002	Change	"from the array will form separate images," changed to "from the array forms separate images,"
1003-1004	Change	"second cylindrical" changed to "[0299] Note that theThe second cylindrical"
1005-1006	Change	"integral. Due to this, there is the" changed to "integral. Thus, there is the"
1007	Change	"FIG. 9 is a" changed to "[0300] FIG. 9 is a"
1008	Change	"laser diode (quasi-CW-LD)" changed to "laser diode (e.g., a quasi-CW-LD)"
1009	Change	"The first beam" changed to "[0301] The first

		beam"
1010-1011	Change	"converter 30 is comprised of" changed to "converter 30 may be comprised of"
1012	Change	"lens 70 are the same as" changed to "lens 70 are substantially the same as"
1013-1014	Change	"same as those explained in FIG. 7 and" changed to "same as those described...reference to FIG. 7 and"
1015	Change	"When using laser" changed to "[0302] When using laser"
1016	Change	"[0303]" changed to ""
1017-1018	Change	"mode instead groups a suitable" changed to "mode instead can group a suitable"
1019	Change	"FIG. 11 is a" changed to "[0304] FIG. 11 is a"
1020	Change	"of another embodiment of" changed to "of another exemplary embodiment of"
1021-1022	Change	"laser device of the present" changed to "laser device according to the present"
1023-1024	Change	"invention, while FIG. 12 is" changed to "invention, and FIG. 12 is"
1025	Change	"The transparent" changed to "[0305] The transparent"
1026	Change	"40 integral." changed to "40 integral. Accordingly,...substantially no breaks."
1027	Deletion	[0306] Due to this, there...substantially no breaks.
1028	Change	"Further, it" changed to "[0307] Further, it"
1029	Change	"the present embodiment can" changed to "the present exemplary embodiment can"
1030	Change	"FIG. 15 is a" changed to "[0308] FIG. 15 is a"
1031	Change	"of another embodiment of" changed to "of another exemplary embodiment of"
1032	Change	"view. The point of difference from" changed to "view. The difference from"
1033	Change	"lens array 80 handles only" changed to "lens array 80 likely handles only"
1034	Change	"The cylindrical" changed to "[0309] The cylindrical"
1035	Insertion	40 integral. Further, the...substantially no breaks.
1036	Deletion	[0310] Further, the...substantially no breaks.
1037	Change	"FIG. 17 is a" changed to "[0311] FIG. 17 is a"
1038	Change	"of another embodiment of" changed to "of another exemplary embodiment of"
1039-1040	Change	"laser device of the present" changed to "laser device according to the present"
1041-1042	Change	"invention, while FIG. 18 is" changed to

		"invention, and FIG. 18 is"
1043	Change	"view. The point of difference from" changed to "view. The difference from"
1044	Change	"[0312] The slow axis...the center axes are" changed to ""
1045	Change	"parallel." changed to "The slow axis components...approximately parallel."
1046	Change	"Therefore, if" changed to "[0313] Therefore, if"
1047-1048	Change	"condensing lens, strictly...in FIG. 4, discrete" changed to "condensing lens, as...to FIG. 4, discrete"
1049-1050	Change	"discrete images are formed." changed to "discrete images can be formed."
1051-1052	Change	"formed. That is, after the" changed to "formed. For example, after the"
1053	Change	"lens array 80, more...thought that the object" changed to "lens array 80, the object"
1054-1055	Change	"the object moves to a position" changed to "the object canbe thought...as moving to a position"
1056-1057	Change	"appear superposed almost completely." changed to "appear superposed, e.g.,...single peak type."
1058	Deletion	[0314] The same applies...single peak type.
1059	Change	"In this" changed to "[0315] In this"
1060-1061	Change	"In this way, at the image-forming" changed to "In this manner, at the image-forming"
1062	Change	"FIGS. 19A to" changed to "[0316] FIGS. 19A to"
1063-1064	Change	"illustrate the above explanation in a manner" changed to "illustrate the above description in a manner"
1065	Change	"and FIG. 18. FIG. 19A" changed to "and FIG. 18. The illustration of FIG. 19A"
1066-1067	Change	"FIG. 19A looks at the output" changed to "FIG. 19A shows the output"
1068-1069	Change	"front. For simplification, part is taken" changed to "front. For the purpose...a part is taken"
1070	Insertion	[0317]
1071-1072	Change	"FIG. 19B shows the cross...figures will be" changed to "FIG. 19B shows the cross... For example, it may be"
1073-1077	Change	"be given to explain the...components is 200 m." changed to "be assumed that the...axis components is 200"
1078	Deletion	[0318] If the focal...of a size of about 1
1079-1088	Change	"m 30/0.3 = 100 m in the...stack array is obtained." changed to "m. If the focal length f1...and about

		200 m"
1089	Deletion	[0319]
1090	Change	"" changed to "30/4.5 = 1.3 mm in the...stack array is obtained."
1091-1092	Change	"practice, there is mounting error" changed to "practice, there may be a mounting error"
1093	Change	"mounting error etc." changed to "mounting error, etc."
1094	Change	"The present embodiment" changed to "The present exemplary embodiment"
1095	Change	"embodiment can also be" changed to "embodiment of the present invention can also be"
1096	Change	"FIG. 20 is a" changed to "[0320] FIG. 20 is a"
1097	Change	"of another embodiment of" changed to "of another exemplary embodiment of"
1098-1099	Change	"laser device of the present" changed to "laser device according to the present"
1100-1101	Change	"invention, while FIG. 21 is" changed to "invention, and FIG. 21 is"
1102	Change	"elevation view. The present" changed to "elevation view thereof. The present"
1103	Change	"The present embodiment" changed to "The present exemplary embodiment"
1104	Change	"embodiment further" changed to "embodiment can further"
1105-1106	Change	"further reduces the image from" changed to "further reduce the image from"
1107-1108	Change	"condenser 70 is provided after" changed to "condenser 70 may be provided after"
1109	Insertion	condenser 71. A further...substantially no breaks.
1110	Deletion	[0321] A further higher...substantially no breaks.
1111	Deletion	[0322] FIG. 22 is a side...the condensing lens 70.
1112	Deletion	[0323] As the optical...from a common object.
1113-1114	Change	"" changed to "[0324] FIG. 22 is a side...the condensing lens 70."
1115	Change	"" changed to "As the optical axis angle...from a common object."
1116	Change	"changing function." changed to "changing function. The...substantially no breaks."
1117	Deletion	[0325] The present...substantially no breaks.
1118	Change	"FIG. 23 is a" changed to "[0326] FIG. 23 is a"
1119	Change	"perspective view of another" changed to "perspective view of still another"
1120	Change	"another embodiment of" changed to "another exemplary embodiment of"

1121-1122	Change	"laser device of the present" changed to "laser device according to the present"
1123	Change	"The present embodiment uses" changed to "The present exemplary embodiment uses"
1124-1125	Change	"embodiment uses as the means for reducing" changed to "embodiment uses as an arrangement for reducing"
1126	Change	"mirrors. For this, four cylindrical" changed to "mirrors. For this purpose, four cylindrical"
1127	Change	"separated." changed to "separated. The first...compression telescope."
1128	Insertion	The telescopes may be the...substantially no breaks.
1129	Deletion	[0327] The first...compression telescope.
1130	Deletion	[0328] The telescopes may...lens 60 may be provided.
1131	Deletion	[0329] The present...substantially no breaks.
1132	Change	"FIG. 24 is a" changed to "[0330] FIG. 24 is a"
1133	Change	"telescopes in the embodiment shown" changed to "telescopes in the exemplary embodiment shown"
1134	Change	"in FIG. 23 ones using cylindrical" changed to "in FIG. 23 using cylindrical"
1135-1136	Change	"cylindrical lenses, in particular using a Kepler" changed to "cylindrical lenses, and...example using a Kepler"
1137	Change	"are used." changed to "are used. FIG. 25 is an...from a common object."
1138	Insertion	As a result, at the...substantially no breaks.
1139	Deletion	[0331] FIG. 25 is an...from a common object.
1140	Deletion	[0332] As a result, at...70 can be made small.
1141	Deletion	[0333] The effect of this...angle changing function.
1142	Deletion	[0334] The present...substantially no breaks.
1143	Deletion	[0335] FIG. 27 is a plan...object is formed there.
1144-1145	Change	"" changed to "[0336] FIG. 27 is a plan...object is formed there."
1146	Change	"[0337] In the original...single beam is about 20" changed to ""
1147-1153	Change	"m, so the overall images...array direction." changed to "In the original array...array direction."
1154	Deletion	[0338] Two-dimensionally,...stripes each are shown.
1155-1156	Change	"" changed to "[0339] Two-dimensionally,...stripes each are shown."
1157	Deletion	[0340] On the other hand,...at intervals of about 44
1158-1166	Change	"m in a total width of...in the stack direction."

		changed to "For the stack direction...in the stack direction."
1167-1168	Change	", however, even" changed to "[0341] If making this...achieved, however, even"
1169	Change	"processing, considering the heat transfer" changed to "processing, the heat transfer"
1170	Change	"workpiece side, whether or" changed to "workpiece side should be considered, whether or"
1171	Insertion	welding of metals. As a...substantially no breaks.
1172	Deletion	[0342] Note that as the...substantially no breaks.
1173	Deletion	[0343] FIG. 30 is a...direction) telescope.
1174	Deletion	[0344] The second beam...fast axis components.
1175-1176	Change	"" changed to "[0345] FIG. 30 is a...direction) telescope."
1177	Change	"Therefore, together" changed to "The second beam converter... Therefore, together"
1178-1179	Change	"the example" changed to "[0346] However, inIn the example"
1180	Change	"is reduced." changed to "is reduced. Therefore, as...(slow axis direction)."
1181	Change	"" changed to "By provision of the fifth...the ghosts disappear."
1182	Deletion	[0347] Therefore, as...(slow axis direction).
1183	Deletion	[0348] By provision of...the ghosts disappear.
1184-1185	Change	"of the properties" changed to "[0349] Note that oneOne of the properties"
1186	Deletion	[0350] Conversely, the...and the stack direction.
1187	Change	"[0351] The present" changed to ""
1188	Change	"embodiment" changed to "Conversely, the beam...exemplary embodiment"
1189	Change	"FIG. 33 is a" changed to "[0352] FIG. 33 is a"
1190	Change	"of another embodiment of" changed to "of another exemplary embodiment of"
1191-1192	Change	"(120, 121). The figure shows" changed to "(120, 121). This figure shows"
1193-1194	Change	"figure shows the case of dividing the group of" changed to "figure shows that the group of"
1195	Change	"group of beams into three to" changed to "group of beams is divided into three to"
1196	Deletion	[0353] Further, FIG. 34...provided between them.
1197-1198	Change	"" changed to "[0354] Further, FIG. 34...provided between them."
1199	Insertion	[0355] The present
1200	Deletion	embodiment can also be...substantially no breaks.
1201	Deletion	[0356] FIG. 35 is a view for explaining

1202	Change	"an optical" changed to "The present exemplary...illustrating an optical"
1203	Change	"[0357] The shift r is...the equation r = t·sin(" changed to ""
1204-1214	Change	"-)/cos(), where =...first beam converter 30." changed to "The shift r is expressed...first beam converter 30."
1215	Change	"" changed to "Further, by arranging it...change to the beams."
1216	Deletion	[0358] Further, by...change to the beams.
1217	Deletion	[0359] FIG. 36 is a...telescopes switched.
1218	Deletion	[0360] The first...slow axis components.
1219-1220	Change	"" changed to "[0361] FIG. 36 is a...telescopes switched."
1221	Change	"" changed to "The first cylindrical...slow axis components."
1222	Insertion	for focusing. As the...substantially no breaks.
1223	Deletion	[0362] As the first...becomes possible.
1224	Deletion	[0363] The present...substantially no breaks.
1225	Deletion	[0364] FIG. 38 is a...and array direction.
1226	Deletion	[0365] The group of beams...use a beam compressor.
1227-1228	Change	"" changed to "[0366] FIG. 38 is a...and array direction."
1229	Change	"" changed to "The group of beams is...use a beam compressor."
1230	Deletion	[0367] The present
1231	Change	"embodiment" changed to "The present exemplary embodiment"
1232	Change	"FIG. 40 is a" changed to "[0368] FIG. 40 is a"
1233	Change	"of another embodiment of" changed to "of another exemplary embodiment of"
1234-1235	Change	"laser device of the present" changed to "laser device according to the present"
1236	Change	"invention. The point of difference" changed to "invention. The difference"
1237-1238	Change	"is that the means for changing" changed to "is that the arrangement for changing"
1239	Insertion	groups of beams. The...substantially no breaks.
1240	Deletion	[0369] The present...substantially no breaks.
1241	Deletion	[0370] As explained using...array (first condenser).
1242-1243	Change	", if there is" changed to "[0371] That isAs...particular, if there is"
1244	Deletion	[0372] Due to this, it is
1245	Change	"preferable" changed to "Due to this, it may be

		preferable"
1246	Change	"An example of" changed to "[0373] An example of"
1247	Deletion	[0374] With the single...order is possible.
1248	Change	"[0375] FIG. 42 shows the...with inclination angles" changed to ""
1249	Change	"" changed to "With the single rotatable...order is possible."
1250-1255	Change	"of 1.5°, 3°, and 4.5°,...plate P2 (abscissa 2)." changed to "FIG. 42 shows the...wedge plate P2 (abscissa"
1256	Deletion	[0376] When the inclination angle
1257	Change	"" changed to "2)."
1258-1262	Change	"is 3°, the rotation angle...radian is possible." changed to "When the inclination...radian is possible."
1263	Insertion	However, since the...may be required.
1264	Deletion	[0377] However, since the...ingenuity are required.
1265	Deletion	[0378] However, whatever...more remarkably.
1266-1267	Change	"" changed to "[0379] However, whatever...more remarkably."
1268	Insertion	stack array. The optical...in optical paths.
1269	Deletion	[0380] The optical...in optical paths.
1270	Change	"The optical" changed to "[0381] The optical"
1271	Deletion	[0382] The optical...first beam converter.
1272	Change	"[0383] Therefore, when...at intervals of 800" changed to ""
1273	Change	"" changed to "The optical elements 32...first beam converter."
1274-1276	Change	"m and stacked every 1.75...of 800 m stacked every" changed to "Therefore, when for...of 800 m stacked every"
1277	Change	"However, as" changed to "[0384] However, as"
1278	Deletion	[0385] For this purpose, it is
1279	Change	"sufficient" changed to "For this purpose, it may be sufficient"
1280	Change	"To meet with" changed to "[0386] To meet with"
1281	Change	"The above optical" changed to "[0387] The above optical"
1282-1283	Change	"principles as shown in U.S." changed to "principles as described in U.S."
1284	Deletion	Patent No. 5,513,201.
1285	Deletion	[0388]
1286	Change	"First, there" changed to "5,513,201, the entire...reference. First, there"

1287	Change	"in FIG. 53." changed to "in FIG. 53. If arranging...rung configuration."
1288	Deletion	[0389] If arranging such...rung configuration.
1289	Deletion	[0390] Such a prism array...as shown in FIG. 55.
1290	Deletion	[0391] If vertically...aligned in parallel.
1291-1292	Change	"" changed to "[0392] Such a prism array...as shown in FIG. 55."
1293	Change	"" changed to "If vertically stacking...aligned in parallel."
1294	Change	"in parallel." changed to "in parallel. Further, the...reflection mirrors."
1295	Change	"" changed to "When using reflection...etc. may be used."
1296	Deletion	[0393] Further, the...reflection mirrors.
1297	Deletion	[0394] When using...etc. may be used.
1298	Deletion	[0395] Fine optical...mirror surfaces.
1299-1300	Change	"" changed to "[0396] Fine optical...mirror surfaces."
1301	Deletion	[0397] FIG. 58 is a view...a suitable distance.
1302	Deletion	[0398] The flat beams...from the emission faces.
1303-1304	Change	"" changed to "[0399] FIG. 58 is a view...a suitable distance."
1305	Change	"" changed to "The flat beams striking...from the emission faces."
1306	Deletion	[0400] FIG. 59 shows a...of cylindrical lenses.
1307	Deletion	[0401] The optical...from the emission faces.
1308	Deletion	[0402] By using the first...arranged in parallel.
1309-1310	Change	"" changed to "[0403] FIG. 59 shows a...of cylindrical lenses."
1311	Change	"" changed to "The optical elements are...from the emission faces."
1312	Change	"" changed to "By using the first beam...arranged in parallel."
1313	Change	"FIG. 60 shows" changed to "[0404] FIG. 60 shows"
1314	Insertion	of FIG. 59. When the...match with the stripes.
1315	Deletion	[0405] When the array of...match with the stripes.
1316	Change	"FIG. 61 shows" changed to "[0406] FIG. 61 shows"
1317	Change	"positions." changed to "positions. Therefore,...a reflective coating."
1318	Insertion	The beam converter may...utilizing diffraction.
1319	Deletion	[0407] Therefore, the...a reflective coating.
1320	Deletion	[0408] The beam converter...to the center axes.
1321-1322	Change	"" changed to "[0409] FIG. 62 is a view...to the

		center axes."
1323	Insertion	emission face. Such a...be produced using dies.
1324	Deletion	[0410] Such a binary...be produced using dies.
1325	Deletion	[0411] FIG. 63 shows a...to the side faces.
1326-1327	Change	"" changed to "[0412] FIG. 63 shows a...to the side faces."
1328	Change	"FIG. 64 shows" changed to "[0413] FIG. 64 shows"
1329	Insertion	outsides. The two...in flat axes about 90°.
1330	Deletion	[0414] The two surfaces...in flat axes about 90°.
1331	Deletion	[0415] FIG. 65 is a...a plan view of the same.
1332	Deletion	[0416] If the anamorphic...the anamorphic prism.
1333	Deletion	[0417] As shown in the...not change in direction.
1334-1335	Change	"" changed to "[0418] FIG. 65 is a...a plan view of the same."
1336	Change	"" changed to "If the anamorphic prism...the anamorphic prism."
1337	Change	"" changed to "As shown in the...not change in direction."
1338	Insertion	single row. Further, if...one anamorphic prism.
1339	Deletion	[0419] Further, if...one anamorphic prism.
1340	Deletion	[0420] The second beam...the beam compressor 40.
1341	Deletion	[0421] When not using the...first beam converter.
1342-1343	Change	"" changed to "[0422] The second beam...the beam compressor 40."
1344	Change	"" changed to "When not using the first...first beam converter."
1345	Insertion	single row. The above...first beam converter.
1346	Deletion	[0423] The above optical...first beam converter.
1347	Change	"First, there" changed to "[0424] First, there"
1348	Insertion	single row. Such a...as shown in FIG. 70.
1349	Deletion	[0425] Such a...as shown in FIG. 70.
1350	Deletion	[0426] The three...first beam converter.
1351	Deletion	[0427] Further, the...reflection mirrors.
1352-1353	Change	"" changed to "[0428] The three...first beam converter."
1354	Change	"" changed to "Further, the optical...reflection mirrors."
1355	Change	"FIG. 72 is a" changed to "[0429] FIG. 72 is a"
1356	Change	"The compressed" changed to "[0430] The compressed"
1357	Insertion	emission faces. By using...rungs to be identical.
1358	Deletion	[0431] By using the...rungs to be identical.

1359	Deletion	[0432] FIG. 73 shows a...to the horizontal plane.
1360	Deletion	[0433] The compressed row...from the emission faces.
1361-1362	Change	"" changed to "[0434] FIG. 73 shows a...to the horizontal plane."
1363	Change	"" changed to "The compressed row of...from the emission faces."
1364	Change	"FIG. 74 shows" changed to "[0435] FIG. 74 shows"
1365	Change	"FIG. 75 shows" changed to "[0436] FIG. 75 shows"
1366	Insertion	cross-section. When...coating in advance.
1367	Deletion	[0437] When joining...coating in advance.
1368	Deletion	[0438] FIG. 76 shows a...and emission faces.
1369-1370	Change	"" changed to "[0439] FIG. 76 shows a...and emission faces."
1371	Change	"FIG. 77 shows" changed to "[0440] FIG. 77 shows"
1372	Insertion	inclined by 45°. A row...90° in cross-section.
1373	Deletion	[0441] A row of parallel...90° in cross-section.
1374	Deletion	[0442] FIG. 78 shows a...the optical glass plate.
1375-1376	Change	"" changed to "[0443] FIG. 78 shows a...the optical glass plate."
1377	Insertion	[0444] As explained above,
1378	Deletion	the present invention can...the laser beams falls.
1379	Deletion	[0445]
1380	Change	"" changed to "As described above, the...the laser beams falls."
1381	Insertion	incidence side. ...occurrence of ghosts.
1382	Deletion	[0446] Due to this, it is...occurrence of ghosts.
1383	Deletion	[0447] FIG. 80 shows the...an integral structure.
1384	Deletion	[0448] Note that FIG. 80...lens is 0.3 mm.
1385	Deletion	[0449] It should be noted...lenses at a slant.
1386-1387	Change	"time, the output" changed to "[0450] At the presentFIG....At that time, the output"
1388	Deletion	larger output is necessary.
1389	Deletion	[0451] Therefore, in the...to increase the output.
1390	Deletion	[0452] That is, in
1391	Change	"the present" changed to "may be needed. ...of the present"
1392	Change	"FIG. 81 shows" changed to "[0453] FIG. 81 shows"
1393	Change	"(polarization prism)." changed to "(polarization prism). ...laser diode stack array."
1394	Change	

		"" changed to "Further, FIG. 83 shows...laser diode stack array."
1395	Insertion	Further, FIG. 84 shows...laser diode stack array.
1396	Deletion	[0454] FIG. 82 shows the...laser diode stack array.
1397	Deletion	[0455] Further, FIG. 83...laser diode stack array.
1398	Deletion	[0456] Further, FIG. 84...laser diode stack array.
1399	Deletion	[0457] Further, in the...groups of laser beams.
1400	Deletion	[0458] In this case, it...as the optical device.
1401-1402	Change	"the present" changed to "[0459] Further,...of the present"
1403	Insertion	laser beams. In this...large output laser beam.
1404	Deletion	[0460] In this way, it is...large output laser beam.
1405	Change	"FIG. 43 is a" changed to "[0461] FIG. 43 is a"
1406	Change	"laser device of the present" changed to "laser device according to...of the present"
1407	Insertion	laser 95. A conventional...laser is possible.
1408	Deletion	[0462] A conventional...laser is possible.
1409	Change	"The semiconductor" changed to "[0463] The semiconductor"
1410	Change	"laser device of the present" changed to "laser device according to...of the present"
1411	Insertion	same object. Further,...laser element 96.
1412	Deletion	[0464] Further, the...laser element 96.
1413	Change	"The semiconductor" changed to "[0465] The semiconductor"
1414	Change	"laser device of the present" changed to "laser device according to...of the present"
1415	Insertion	laser 95. As the...may also be utilized.
1416	Deletion	[0466] As the solid-state...may also be utilized.
1417	Change	"Further, the" changed to "[0467] Further, the"
1418	Change	"FIG. 45 is a" changed to "[0468] FIG. 45 is a"
1419	Deletion	[0469] Due to the length...to the target location.
1420	Change	"[0470] Note that a laser...a core diameter of 400" changed to ""
1421-1423	Change	"m achieves an efficiency of 60%." changed to "Due to the length and...an efficiency of 60%."
1424	Change	"FIG. 47 is a" changed to "[0471] FIG. 47 is a"
1425	Change	"The output part" changed to "[0472] The output part"
1426	Change	"[0473]" changed to ""
1427	Insertion	becomes easy. The optical...laser element.
1428	Deletion	[0474] The optical fiber...laser element.
1429	Deletion	[0475] FIG. 49 is a...view of the same.
1430-1431	Change	"" changed to "[0476] FIG. 49 is a...view of the

		same."
1432	Deletion	CLAIMS
1433	Deletion	A semiconductor laser device provided with:
1434	Deletion	1. a laser diode stack...a two-dimensional array;
1435	Deletion	2. a first condenser (20)...to said first direction;
1436	Deletion	3. a first beam converter...direction for every row;
1437	Deletion	4. a second condenser...of the optical axes;
1438	Deletion	5. a first beam...plurality of rows; and
1439	Deletion	6. a third condenser (70)...beam compressor (40).
1440	Deletion	A semiconductor laser device provided with:
1441	Deletion	7. one of a laser diode...in a plurality of rows;
1442	Deletion	8. a first condenser (20)...to said first direction;
1443	Deletion	9. a first beam converter...of laser beams as units;
1444	Deletion	10. a second condenser...of the optical axes;
1445	Deletion	11. a first beam...plurality of rows; and
1446	Deletion	12. a third condenser...beam compressor (40).
1447	Deletion	A semiconductor laser device provided with:
1448	Deletion	13. a laser diode stack...a two-dimensional array;
1449	Deletion	14. a first condenser...to said first direction;
1450	Deletion	15. a first beam...direction for every row;
1451	Deletion	16. a second condenser...direction for every row;
1452	Deletion	17. a first beam...the plurality of rows;
1453	Deletion	18. an angle changer...the same object; and
1454	Deletion	19. a third condenser...in center optical axes.
1455	Deletion	A semiconductor laser device provided with:
1456	Deletion	20. one of a laser diode...in a plurality of rows;
1457	Deletion	21. a first condenser...to said first direction;
1458	Deletion	22. a first beam...of laser beams as units;
1459	Deletion	23. a second condenser...direction for every row;
1460	Deletion	24. a first beam...the plurality of rows;
1461	Deletion	25. an angle changer...the same object; and
1462	Deletion	26. a third condenser...group of laser beams.
1463	Deletion	27. A semiconductor laser...are formed integrally.
1464	Deletion	A semiconductor laser device provided with:

1465	Deletion	28. a laser diode stack...a two-dimensional array;
1466	Deletion	29. a first condenser...to said first direction;
1467	Deletion	30. a first beam...direction for every row;
1468	Deletion	31. a second condenser...for every row; and
1469	Deletion	32. a third condenser...distance between rows.
1470	Deletion	A semiconductor laser device provided with:
1471	Deletion	33. one of a laser diode...in a plurality of rows;
1472	Deletion	34. a first condenser...to said first direction;
1473	Deletion	35. a first beam...of laser beams as units;
1474	Deletion	36. a second condenser...for every row; and
1475	Deletion	37. a third condenser...distance between rows.
1476	Deletion	A semiconductor laser device provided with:
1477	Deletion	38. a laser diode stack...a two-dimensional array;
1478	Deletion	39. a first condenser...to said first direction;
1479	Deletion	40. a first beam...direction for every row;
1480	Deletion	41. a second condenser...direction for every row;
1481	Deletion	42. a fourth condenser...between rows; and
1482	Deletion	43. a third condenser...fourth condenser (71).
1483	Deletion	A semiconductor laser device provided with:
1484	Deletion	44. one of a laser diode...in a plurality of rows;
1485	Deletion	45. a first condenser...to said first direction;
1486	Deletion	46. a first beam...of laser beams as units;
1487	Deletion	47. a second condenser...direction for every row;
1488	Deletion	48. a fourth condenser...between rows; and
1489	Deletion	49. a third condenser...fourth condenser (71).
1490	Deletion	50. A semiconductor laser...the same object.
1491	Deletion	A semiconductor laser device provided with:
1492	Deletion	51. a laser diode stack...a two-dimensional array;
1493	Deletion	52. a first condenser...to said first direction;
1494	Deletion	53. a first beam...direction for every row;
1495	Deletion	54. a second condenser...direction for every row;
1496	Deletion	55. a first beam...the plurality of rows;
1497	Deletion	56. a second beam...the plurality of rows;
1498	Deletion	57. a fourth condenser...second direction; and
1499	Deletion	58. a third condenser...fourth condenser (60).
1500	Deletion	A semiconductor laser device provided with:
1501	Deletion	59. one of a laser diode...in a plurality of rows;
1502	Deletion	60. a first condenser...to said first direction;

1503	Deletion	61. a first beam...of laser beams as units;
1504	Deletion	62. a second condenser...direction for every row;
1505	Deletion	63. a first beam...the plurality of rows;
1506	Deletion	64. a second beam...the plurality of rows;
1507	Deletion	65. a fourth condenser...second direction; and
1508	Deletion	66. a third condenser...fourth condenser (60).
1509	Deletion	A semiconductor laser device provided with:
1510	Deletion	67. a laser diode stack...a two-dimensional array;
1511	Deletion	68. a first condenser...to said first direction;
1512	Deletion	69. a first beam...direction for every row;
1513	Deletion	70. a second condenser...direction for every row;
1514	Deletion	71. a first beam...the plurality of rows;
1515	Deletion	72. a second beam...the plurality of rows;
1516	Deletion	73. an angle changer...optical axis angles; and
1517	Deletion	74. a third condenser...group of laser beams.
1518	Deletion	A semiconductor laser device provided with:
1519	Deletion	75. one of a laser diode...in a plurality of rows;
1520	Deletion	76. a first condenser...to said first direction;
1521	Deletion	77. a first beam...of laser beams as units;
1522	Deletion	78. a second condenser...direction for every row;
1523	Deletion	79. a first beam...the plurality of rows;
1524	Deletion	80. a second beam...the plurality of rows;
1525	Deletion	81. an angle changer...optical axis angles; and
1526	Deletion	82. a third condenser...group of laser beams.
1527	Deletion	83. A semiconductor laser...second beam compressor.
1528	Deletion	84. A semiconductor laser...said second direction.
1529	Deletion	A semiconductor laser...further provided with:
1530	Deletion	85. a second beam...second direction and
1531	Deletion	86. an angle changer...the same object.
1532	Deletion	87. A semiconductor laser...laser beams of each row.
1533	Deletion	88. A semiconductor laser...is a cylindrical lens.
1534	Deletion	89. A semiconductor laser...direction for each row.
1535	Deletion	90. A semiconductor laser...direction for each row.
1536	Deletion	91. A semiconductor laser...of cylindrical

		lenses.
1537	Deletion	A semiconductor laser device provided with:
1538	Deletion	92. a laser diode stack...a two-dimensional array;
1539	Deletion	93. a first condenser...to said first direction;
1540	Deletion	94. a second beam...said second direction;
1541	Deletion	95. a first beam...of laser beams as units;
1542	Deletion	96. a first beam...in said first direction;
1543	Deletion	97. a second condenser...second direction; and
1544	Deletion	a third condenser (70)...group of laser beams.
1545	Deletion	98. A semiconductor laser device provided with:
1546	Deletion	99. one of a laser diode...in a plurality of rows;
1547	Deletion	100. a first condenser...to said first direction;
1548	Deletion	101. a second beam...said second direction;
1549	Deletion	102. a first beam...of laser beams as units;
1550	Deletion	103. a first beam...in said first direction;
1551	Deletion	104. a second condenser...second direction; and
1552	Deletion	105. a third condenser...group of laser beams.
1553	Deletion	106. A semiconductor...said second direction.
1554	Deletion	107. A semiconductor...is a cylindrical lens.
1555	Deletion	108. A semiconductor...the same object.
1556	Deletion	109. A semiconductor...array of wedge prisms.
1557	Deletion	110. A semiconductor...of cylindrical lenses.
1558	Deletion	111. A semiconductor...type reflection mirror.
1559	Deletion	112. A semiconductor...anamorphic prism pair.
1560	Deletion	113. A semiconductor...two-dimensional lenses.
1561	Deletion	114. A semiconductor...parabolic mirror.
1562	Deletion	115. A semiconductor...of cylindrical lenses.
1563	Deletion	116. A semiconductor...said second direction.
1564	Deletion	117. A semiconductor...least one wedge plate.
1565	Deletion	118. A semiconductor...each provided with:
1566	Deletion	119. a receiving part for...axes as first axes,
1567	Deletion	120. an optical system...right angles, and
1568	Deletion	121. an emission part for...said optical system,
1569	Deletion	122. said optical...on the same planes.
1570	Deletion	123. A semiconductor...to the horizontal plane.
1571	Deletion	124. A semiconductor...as said beam converter.
1572-1574	Deletion	125. A semiconductor...as a beam converter.
1575-1577	Deletion	126. A semiconductor...as a beam converter.
1578	Deletion	127. A semiconductor...predetermined distance.
1579	Deletion	128. A semiconductor...predetermined distance.
1580	Deletion	129. A semiconductor...incidence side lenses.
1581	Deletion	130. A semiconductor...incidence optical axis.

1582	Deletion	131. A semiconductor...incidence optical axis.
1583	Deletion	132. A semiconductor...incidence side lenses.
1584	Deletion	133. A semiconductor...90° in cross-section.
1585	Deletion	134. A semiconductor...90° in cross-section.
1586	Deletion	135. A semiconductor...inclined by about 45°.
1587	Deletion	136. A semiconductor...axes inclined about 45°.
1588	Deletion	137. A semiconductor...90° in cross-section.
1589	Deletion	138. A semiconductor...to a horizontal plane.
1590	Deletion	139. A semiconductor...to a horizontal plane.
1591	Deletion	140. A semiconductor...further to the outsides.
1592	Deletion	141. A semiconductor...of said condensers.
1593	Deletion	142. A semiconductor...after said condenser.
1594	Deletion	143. A semiconductor...after said condenser.
1595	Deletion	144. A semiconductor...a polarization element.
1596	Deletion	145. A semiconductor...laser diode stack array.
1597	Deletion	146. A semiconductor...laser diode stack array.
1598	Deletion	147. A semiconductor...laser diode stack array.
1599	Deletion	148. A semiconductor...is a dichroic mirror.
1600	Deletion	149. A semiconductor...of said third condenser.
1601	Deletion	150. A semiconductor...a rare earth element.
1602	Deletion	151. A semiconductor...of said third condenser.
1603	Deletion	152. A semiconductor...of said focal point.
1604	Deletion	153. A semiconductor...a rare earth element.
1605	Deletion	**ABSTRACT OF THE DISCLOSURE**
1606	Deletion	A semiconductor laser...to a single image.

Statistics:	
	Count
Insertions	596
Deletions	1010
Moved from	0
Moved to	0
Style change	0
Format changed	0
Total changes	1606